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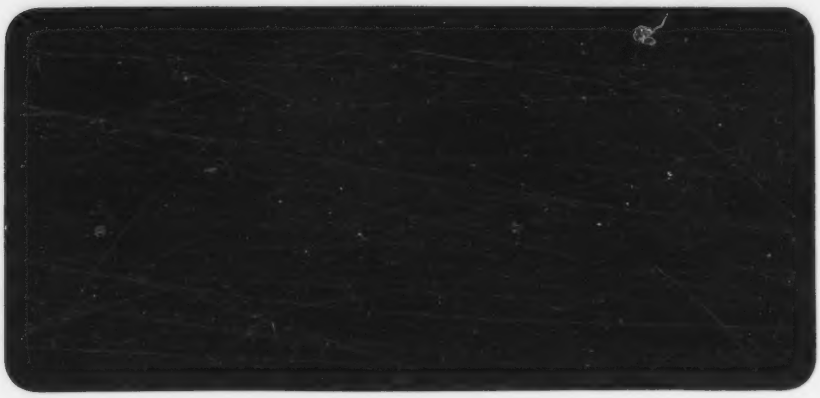

Department of Finance

Economic and Fiscal Policy Branch

Working papers are circulated in the language of preparation, to make analytic work undertaken by the staff available to a wider readership. They have received only limited evaluation and do not reflect the views of the Department of Finance. Comments on the working papers are invited and may be sent to the author(s).

The Interaction of Inflation With a Canadian-Type Capital Tax System: a Dynamic General Equilibrium Analysis Incorporating Endogenous Leverage and Heterogeneous Households

by
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Résumé

Ce travail décrit la construction d'un modèle dynamique d'équilibre général calculable avec un levier financier endogène et des ménages hétérogènes détenteurs et non détenteurs de titres boursiers. Les décisions prises tant par les entreprises que par les ménages se fondent sur l'évolution future anticipée du revenu du capital et du travail, des taux d'intérêt réels après impôt et du rendement sur les titres boursiers. Le modèle est simulé afin de déterminer l'état stationnaire et l'importance des non neutralités engendrés par l'interaction entre un système d'imposition du capital et des chocs temporaires, permanent ou retardés du taux d'inflation. Les résultats de la simulation laissent croire qu'une réduction permanente et anticipée du taux d'inflation peut entraînée, par ses interactions avec un système d'imposition du capital similaire à celui du Canada, une augmentation du stock de capital, de la production et du bien-être. Les gains estimés de cette réduction du taux d'inflation sont supérieurs quand le levier financier est endogène et s'accroissent à mesure qu'augmente le taux d'inflation du scénario de contrôle. Ces gains sont élevés même lorsqu'il est prévu que la réduction permanente de l'inflation ne surviendra qu'au bout d'un certain temps. Cependant, une réduction temporaire et anticipée du taux d'inflation engendre beaucoup moins de bénéfices. En général, les résultats suggèrent que bien que des réductions anticipées de courte et de longue durée du taux d'inflation peuvent générées des améliorations à la Pareto, il est possible qu'il existe une durée intermédiaire pour laquelle le ménage détenteur de titre sera en meilleure position alors que le ménage non détenteur verra sa situation se dégrader. Toutefois, le gain de bien-être peut être supérieur, pour des réductions temporaires de n'importe laquelle durée, sous plusieurs hypothèses de pondérations des différents types agents économiques.

Abstract

The paper constructs a dynamic computable general equilibrium model incorporating endogenous leverage and heterogeneous equity and non-equity holding households. The decisions of both firms and households are based upon expected future paths of capital and labour income, real after-tax interest rates and equity returns. The model is simulated to determine the steady-state and dynamic magnitudes of nonneutralities generated by the interaction of temporary, permanent and delayed inflation shocks with the capital tax system. The simulation results suggest that a permanent anticipated reduction in inflation can, through interactions with a capital tax system similar to that of Canada, generate significant increases in the capital stock, output and welfare. The estimated capital tax interaction benefits of reduced inflation are greater when leverage is modelled as endogenous, and the impact upon the estimated gain increases as the level of the control scenario inflation rate rises. The capital tax interaction gains from reduced inflation are substantial even when the permanent inflation reduction is anticipated to be delayed until some future point. Anticipated temporary inflation reductions, however, yield significantly smaller benefits. The results suggest that while short and long anticipated inflation reductions can lead to a Pareto improvement, there can also exist an intermediate length of anticipated reduction which makes the equity-holding household better off, but the non-equity-holding household worse off. Social welfare may, nevertheless, be higher for temporary reductions of any length over a wide range of agent weightings.

1 Introduction

The capital tax system can provide an important basis for the existence of inflation nonneutralities. The corporate deductibility of nominal interest costs, personal taxation of nominal interest income and differing rates of corporate and personal tax imply that real after-corporate and after-personal interest rates cannot both be inflation-invariant. Inflation lowers the depreciation firms can claim below that available if the capital stock were evaluated on the basis of replacement cost, thereby increasing the effective tax rate on corporate profits, affects the level of inventory valuation adjustments under FIFO accounting practices and the present value of future capital gains taxes collected on a realized rather than an accruals basis.

In general, a change in inflation will, like a change in statutory capital tax rates, alter the marginal cost of debt relative to equity, inducing firms to adjust leverage in order to re-equate these costs. The financial structure and capital tax incidence literature has identified a number of ways in which capital taxes and inflation interact and can affect optimal leverage. The pathbreaking work of Modigliani and Miller (1958) showed that, in a world without taxes or leverage costs, leverage is irrelevant to firm value and the cost of capital. This is because agents can construct portfolios which recreate the returns and risk mix of any combination of debt and equity the firm might offer. If leverage does not affect the total consumption possibilities of individuals, firms can obtain no financing advantage by changing their debt-equity mix. In such a world, inflation does not affect leverage. The assumptions of no taxes and leverage costs which are critical in generating the original Modigliani-Miller leverage irrelevancy result are, however, plainly unrealistic. Much of the corporate finance literature since the seminal Modigliani-Miller analysis has

been devoted to elaborating their framework to incorporate the features of actual personal and corporate tax structures and leverage costs, and to determining how these features affect capital tax incidence and can generate an interior leverage optimum. Key contributions have included Modigliani and Miller (1963; 1966) which introduced corporate taxes, Stiglitz (1969; 1973; 1974), King (1977), Miller (1977), Nickell (1978), DeAngelo and Masulis (1980), Modigliani (1982), Gordon and Malkiel (1981), Bradley, Jarrell and Kim (1984), Bartholdy, Fisher and Mintz (1987), Dammon and Senbet (1988) and Gertler and Hubbard (1989; 1991).

In general, an interior leverage optimum can occur when the deductibility of corporate interest payments at a rate exceeding the personal tax rate creates a debt financing tax advantage which causes the cost of funds to fall and firm value to rise as leverage increases until the point when leverage-related costs more than offset the tax benefit. These costs include the rising risk of incurring bankruptcy and reorganization costs as leverage rises, and the imposition of agency costs which stem from to the separability of ownership and control in large corporations, as in the framework of Jensen and Meckling (1976) and Chen and Kim (1979). In the DeAngelo and Masulis (1980) framework, higher leverage lowers the probability that corporate tax shield substitutes will be fully usable in low earnings states of the world. Higher inflation raises nominal interest rates, thereby increasing the tax advantage of leverage since corporations can deduct nominal interest at a tax rate in excess of the average effective marginal personal tax rate on interest income. The relevance of inflation for financial policy has been considered by, among others, Feldstein, Green and Sheshinski (1978), Hamada (1979), Gordon (1980), DeAngelo and Masulis (1980) Modigliani (1982), Schall (1984) and Hochman and Palmon (1985).

The financial structure literature has been largely set within a partial equilibrium framework. Significant empirical general equilibrium insight into the long-run effects (excluding financial structure-relevant mechanisms) of capital tax policies was provided by the first generation of large-scale static general equilibrium models such as that of Harberger (1962) and Shoven and Whalley (1972). The absence of any treatment of time in these models, however, made them incapable of analyzing issues involving intertemporal choice, such as the impact of government policy on savings and growth. In an attempt to overcome this drawback, dynamic, steady-state general equilibrium models were developed in the late 1970s and early 1980s. While such models can generate steady-state solutions for control and shock scenarios, their lack of treatment of expectations prevents them from providing information regarding the length of the transition time required for the new steady state to be achieved, or the dynamic characteristics of the transition path. They cannot be used to analyze the impact of temporary shocks and policy changes, which may be zero in the steady state, but dynamically significant in the short and medium-term.

Dynamic general equilibrium models with forward-looking model-consistent expectations bridge this gap, providing insights into dynamic and transitional issues lacking in their static and steady-state counterparts. This can be accomplished within an internally consistent optimizing framework not present in conventional macroeconomic models. They are capable of examining the dynamic and steady-state impacts of permanent and temporary changes in inflation, risk, the personal and corporate tax structure, the deficit regime and

demographic patterns, to give an incomplete list. Computable versions of these models have come into increasing use within the last five years. Prominent examples are the aggregated multi-country model of McKibbin and Sachs (1986), the overlapping generations life cycle model of Auerbach and Kotlikoff (1987) developed specifically to examine fiscal policy questions, the multi-sector model of Goulder and Summers (1989) which focuses on capital taxation and financial market issues, the open economy model of Goulder and Eichengreen (1992), which is used to analyze the effects of trade liberalization, and the small open economy model of Macklem (1991), which is designed to examine the effects of terms of trade disturbances and alternative fiscal policies for a resource-exporting, small open economy such as Canada.

In this paper we seek to determine the steady-state and dynamic magnitudes of nonneutralities generated by the interaction of temporary, permanent and delayed inflation shocks with the capital tax system. To accomplish this, a dynamic computable general equilibrium model is constructed incorporating features drawn from the partial equilibrium analyses of the financial structure and capital tax incidence literature and from previous dynamic general equilibrium studies. The approach taken necessitates the modelling of four key decisions. These are the consumption-savings decision of households, the portfolio choice of households, the investment decision of firms and the leverage decision of firms. Households are assumed to choose their consumption-savings and portfolio mix paths in order to maximize welfare, while firms invest and select their financial structure in order to maximize shareholder wealth. Households are assumed to be infinitely-lived dynasties whose members regard the welfare of subsequent generations as equivalent to their own (subject to discounting), and to whom they leave altruistically-motivated bequests. Households are the firm's shareholders, and it is their decision to save which provides funds for firm investment. In general equilibrium, aggregate firm financial structure must be consistent with the aggregate household portfolio choice. The decisions of both firms and households are based upon expected future paths of capital and labour income, real interest rates and capital costs. The model is roughly calibrated to a 1990 Canadian benchmark. The model is closed, and in this regard it is effectively equivalent to Goulder and Summers (1990) model in which the exchange rate adjusts to bring about current account balance in every period. Although Canada is a small open economy, initially constructing a closed model has a number of advantages. A variety of simulations may be conducted and interpreted under the assumption that the relevant shocks and policy innovations are global, and the model may be regarded as a generic case representing the United States or the G7 economies as a whole.

Section 2 presents the formal maximization problems of the equity and non-equity holding households and the optimal consumption and portfolio solutions to these problems. Section 3 defines the representative firm's objective and provides the optimal investment and financial structure decisions. Section 4 states the equilibrium conditions and summarizes the computable model's solution method. Section 5 summarizes the characteristics of the benchmark data set and model parameters, provides the steady-state and dynamic impacts obtained from a series of simulations of permanent, temporary and delayed inflation reductions. The sensitivity of the results to alternative assumptions is examined, and the capital tax interaction effects of lower inflation are compared with those

generated by a series of statutory capital tax changes. Section 6 summarizes and draws conclusions from the results.

2 Household Behaviour

The objective of households is to maximize utility subject to an intertemporal budget constraint or asset accumulation condition. Utility consists of the sum of expected instantaneous utility flows from consumption discounted over an infinite horizon. This assumption can be easily altered by incorporating a positive probability of household death as in the Blanchard perpetual youth model (1985). This would need to be done for any realistic analysis of fiscal policy issues. It is not, however, necessary for the analysis of inflation-capital tax interactions with which we are primarily concerned here.

Mehra and Prescott (1984) found that over the period 1889-1979 the U.S. equity return averaged 7 per cent and the real 90 day treasury bill rate averaged 0.8 per cent, with a resulting average equity risk premium of 6.2 per cent. Using a representative agent model and empirically acceptable degrees of risk aversion, they were unable to reconcile so large a risk premium with so low a risk-free rate. Saito (1992) argued that the equity premium puzzle could be resolved in a heterogeneous agent framework. Motivated by the observation that the ownership of risky assets is confined to a relatively small group of agents he constructed a model in which a significant portion of consumers do not participate in the stock market owing to the existence of fixed participation costs. Aggregate risk is thus concentrated entirely on stockholders, who require a high compensation for bearing this risk. Our modelling of the household sector follows this heterogeneous agent approach. We assume the existence of two types of households: those that hold equity and corporate debt, and those that do not. We turn first to the maximization problem of the equity and corporate debt-holding household.

2.1 The Maximization Problem of the Equity-Holding Household

The representative equity-holding household (household A) chooses paths for consumption, C^A, the share of corporate bonds in the bond portfolio, φ, and the share of bonds in the total portfolio, b, in order to solve the problem:

$$\max \boldsymbol{E} \int_0^{\infty} (e^{-\rho s} C_s^{A\,\xi} / \xi \,) ds \tag{2.1}$$

subject to the asset accumulation condition:

$$\begin{aligned} dA_s^A &= \{[r_s^G (1 - \tau_s^{KB}) - \pi_s](1 - \varphi_s) b_s A_s^A \\ &+ [r_s^C (1 - \tau_s^{KB}) - \pi_s] \varphi_s b_s A_s^A + (1 - \tau_s^{KE}) e_s (1 - b_s) A_s^A - C_s^A \} ds \\ &+ \{[(1 - \tau_s^{KE})(1 - b_s) \sigma_s^E + (1 - \tau_s^{KB}) b_s \varphi_s \sigma_s^{BC}\} A_s^A \, dz \end{aligned} \tag{2.2}$$

where ρ is the rate of time preference, $-1/(\xi - 1)$ is the intertemporal elasticity of substitution, z is a Wiener process, π is the rate of inflation, r^G is the nominal interest rate on safe government bonds, r^C is the nominal interest rate on corporate bonds, e is the real pre-personal tax return (dividends plus capital gains) on equity, τ^{KE} is the average effective personal tax rate on equity income (dividends plus capital gains), τ^{KB} is the personal tax rate on interest income and $(\sigma^E)^2$ and $(\sigma^{BC})^2$ are the instantaneous variances per unit of time of the pre-personal tax returns on equity and corporate bonds, respectively[1]. Since nominal interest income is taxed, the expected instantaneous real after-personal tax return per unit of time on a bond paying an expected nominal return of r is $r(1 - \tau^{KB}) - \pi$. The expression $\{\bullet\}$ in $\{\bullet\}ds$ is the deterministic portion of the returns and $\{\bullet\}$ in $\{\bullet\}dz$ is the stochastic portion of the returns. The equity-holding household is assumed to receive no labour income, hence its wealth will equal its capital asset holdings.

The above formulation of the instantaneous capital return variances per unit of time has the drawback that while the total (equity plus debt) capital return of a single firm can be characterized as a Wiener process, the same is not true of the equity and debt returns themselves, given that the bond return will actually be r^C and the equity return be log-normally distributed whenever the firm is not in default, while the bond return will be log-normally distributed (and less than r^C) and the equity return will be zero whenever the firm is in default. An analytic solution can be obtained by using the Merton (1970) assumption that the bond return follows a Poisson process, however, this has the shortcoming that the bond return will be zero, rather than log-normally distributed, over all default states. The characterization given by equation (2.2) has the advantage of being easily combined with equity and debt return variance-leverage relationships in order to generate an analytically solvable interior leverage optimum.

2.2 The Maximization Problem of the Non-Equity-Holding Household

The representative non-equity-holding household solves the problem:

$$\max \boldsymbol{E} \int_0^{\infty} (e^{-\rho s} C_s^{B\,\xi} / \xi)\,ds \tag{2.3}$$

$$\text{s.t. } dA_s^B = \{[r_s^G (1 - \tau_s^{KB}) - \pi_s] A_s^B + w_s^B - T_s^B + R_s^B - C_s^B\}\,ds \tag{2.4}$$

where w is pre-personal tax labour income, T is personal taxes and R is personal transfers, all of which are assumed to be deterministic. The characterizations (2.2) and (2.4) of the asset accumulation conditions imply that all output uncertainty is borne by corporate asset

1. For expositional simplicity, the household maximization problems and their solutions are presented in continuous time, however, their discrete time analogues are used in the computable version of the model.

holders. This uncertainty may be regarded as stemming from a variety of sources, including technology shocks and equilibrium noise trading in equity markets.

In order to ensure that the market value of an asset may not permanently grow faster than its rate of return, households are assumed to enforce a transversality condition upon private and government issuers of assets. In the case of bonds, this rules out Ponzi games in which interest obligations can ultimately be met only through the issuance of yet more bonds. In the case of equity, it excludes the possibility of eternal speculative bubbles in which share values exceed the levels warranted by income fundamentals.

2.3 The Consumption and Portfolio Decisions of the Equity-Holding Household

Solving the equity and corporate debt-holding household's constrained intertemporal optimization problem involves selecting an optimal portfolio each period and choosing an optimal consumption path, given expected asset returns and variances, income streams and wealth. The optimal consumption problems have closed-form solutions which can be obtained using the techniques of dynamic programming. For simplicity, the equity-debt return covariance is assumed to be near zero and is not included in the derivations. This will clearly not strictly hold, but the approximation may be rationalized by recognizing that whenever the firm is in default, the equity return is zero, with the full (if positive) stochastic capital return devolved to the bondholders, while in the non-default state the stochastic deviation of total from trend capital income will devolve to the equity-holders.

The optimal consumption path solution of the equity and corporate debt-holding household is:

$$C_t^{\wedge} = m_t W_t^{\wedge} \tag{2.5}$$

where:

$$m_t^{\wedge} = \{ \int_t^{\infty} \exp[\int_t^{s} [\xi \hat{r}_u^{\wedge} /(1 - \xi)]du - \rho s/(1 - \xi)]ds \}^{-1} \tag{2.6}$$

and:

$$\begin{aligned} \hat{r}_u^{\wedge} &= \{[r_u^G (1 - \tau_u^{KB}) - \pi_u](1 - \varphi_u)b_u + [r_u^C (1 - \tau_u^{KB}) - \pi_u]\varphi_u b_u \\ &+ (1 - \tau_u^{KE})e_u(1 - b_u)\} + \tfrac{1}{2}(\xi - 1)\{(1 - \tau_u^{KE})^2(1 - b_u)^2(\sigma_u^E)^2 \\ &+ (1 - \tau_u^{KB})^2 b_u^2 \varphi_u^2 (\sigma_u^{BC})^2\} \end{aligned} \tag{2.7}$$

All government bonds are assumed to be held by non-equity holding households, hence aggregate equity-holding household wealth consists of the sum of corporate equity and debt:

$$W_t^A = S_t + B_t^C \tag{2.8}$$

The optimal share of bonds in the total portfolio of equity-holding households is:

$$b_t = \{(1 - \tau_t^{KE})^2(\sigma_t^E)^2(1 - \xi) + [r_t^G(1 - \tau_t^{KB}) - \pi_t](1 - \varphi_t)$$
$$+ [r_t^C(1 - \tau_t^{KB}) - \pi_t]\varphi_t - (1 - \tau_t^{KE})e_t\}/\{\{(1 - \tau_t^{KE})^2(\sigma_t^E)^2$$
$$+ (1 - \tau_t^{KB})^2\varphi_t^2(\sigma_t^{BC})^2\}(1 - \xi)\} \tag{2.9}$$

while the optimal share of corporate bonds in its bond portfolio is:

$$\varphi_t = (r_t^C - r_t^G)/[(1 - \tau_t^{KB})b_t(\sigma_t^{BC})^2(1 - \xi)] \tag{2.10}$$

The welfare of equity-holding households, V^A, is given by:

$$V_t^A = (m_t^A)^{\xi-1}(W_t^A)^{\xi}/\xi \tag{2.11}$$

2.4 The Consumption Decision of the Non-Equity-Holding Household

The optimal consumption path solution of the non-equity-holding household is:

$$C_t^B = m_t^B W_t^B \tag{2.12}$$

where:

$$m_t^B = \{ \int_t^\infty \exp[\int_t^s [\xi \hat{r}_u^B /(1 - \xi)]du - \rho s/(1 - \xi)]ds \}^{-1} \tag{2.13}$$

$$\hat{r}_u^B = r_u^G (1 - \tau_u^{KB}) - \pi_u \tag{2.14}$$

$$W_t^B = \int_t^\infty (w_s - T_s + R_s) \exp[\int_t^s - \hat{r}_u^B du]ds + A_t^B \tag{2.15}$$

or equivalently:

$$W_t^B \equiv W_t^K + W_t^L - S_t - B_t^C + B_t^G - W_t^{PR} \tag{2.16}$$

where W^L is pre-tax-and-transfer human capital wealth, W^{PR} is the present value of future primary balances and pre-tax physical capital wealth, W^K, is given by:

$$W_t^K = \int_t^\infty (Y_s^K - \delta K_s) \exp[\int_t^s - \gamma_u^{KAP} du]ds \tag{2.17}$$

where Y^K is pre-tax net capital income, k is the ratio of after-tax to pre-tax capital income and γ^{AP} is the after-personal tax return on capital:

$$\gamma_t^{KAP} = k_t\gamma_t^{AP} + (1 - k_t)\hat{r}_t^B \tag{2.18}$$

Pre-tax-and-transfer human capital wealth is given by:

$$W_t^L = \int_t^\infty Y_s^L \exp\left[\int_t^s -\hat{r}_u^B\, du\right]ds \tag{2.19}$$

where Y^L is pre-tax labour income.

Given the infinite household planning horizons, the stock of government debt satisfies:

$$B_t^G = W_t^{PR} = \int_t^\infty G_s^{PR} \exp\left[\int_t^s -\hat{r}_u^B\, du\right]ds \tag{2.20}$$

where G^{PR} is the government primary balance. Total wealth, W, is thus given by:

$$\begin{aligned} W_t &\equiv W_t^A + W_t^B \\ &= W_t^K + W_t^L \end{aligned} \tag{2.21}$$

The welfare of non-equity-holding households is given by:

$$V_t^B = (m_t^B)^{\xi-1}(W_t^B)^{\xi}/\xi \tag{2.22}$$

The analogous discrete time solutions for the propensities to consume are:

$$m_t^A = \{\sum_{s=1}^{\infty} \prod_{j=1}^{s} (1 + \hat{r}_j^A)^{\xi(1-\xi)}/(1+\rho)^{(s-1)(1-\xi)}\}^{-1} \quad (2.23)$$

$$m_t^B = \{\sum_{s=1}^{\infty} \prod_{j=1}^{s} (1 + \hat{r}_j^B)^{\xi(1-\xi)}/(1+\rho)^{(s-1)(1-\xi)}\}^{-1} \quad (2.24)$$

which have the recursive forms:

$$(m_t^A)^{-1} = 1 + (m_{t+1}^A)^{-1} (1 + \hat{r}_t^A)^{\xi(1-\xi)}/(1+\rho)^{1/(1-\xi)} \quad (2.25)$$

$$(m_t^B)^{-1} = 1 + (m_{t+1}^B)^{-1} (1 + \hat{r}_t^B)^{\xi(1-\xi)}/(1+\rho)^{1/(1-\xi)} \quad (2.26)$$

3 Firm Behaviour

3.1 The Firm's Objective

Representative firms choose levels of investment and financial structure in order to maximize the market value of equity, which is the discounted value of after-tax dividends net of new share issues. The discount rate is determined by equating the required after-personal tax equity return with the sum of the after-tax dividend-price ratio and the after-tax rate of capital gain per share:

$$e_t = (1 - \tau_{t+1}^{KD})D_t/S_t + (1 - \tau_{t+1}^{KK})(S_{t+1} - S_t - \Delta S_{t+1}^N)/S_t - \tau_{t+1}^{KK}\pi_{t+1} \quad (3.1)$$

where D is real dividends, S is the real market value of equity, ΔS^N is new share issues, τ^{KD} is the tax rate on dividend income and τ^{KK} is the tax rate on capital gains income. Rewriting and taking the discounted sum to time T:

$$\begin{aligned}
&\sum_{s=1}^{T} S_{s+1}/\prod_{j=1}^{s} [1 + (e_j + \tau_{j+1}^{KK}\pi_{j+1})/(1 - \tau_{j+1}^{KK})] \\
&= \sum_{s=1}^{T} S_s[1 + (e_s + \tau_{s+1}^{KK}\pi_{s+1})/(1 - \tau_{s+1}^{KK})] \\
&/\prod_{j=1}^{s} [1 + (e_j + \tau_{j+1}^{KK}\pi_{j+1})/(1 - \tau_{j+1}^{KK})] \\
&- \sum_{s=1}^{T} \{[(1 - \tau_{s+1}^{KD})/(1 - \tau_{s+1}^{KK})]D_s - \Delta S_{s+1}^N\} \\
&/\prod_{j=1}^{s} [1 + (e_j + \tau_{j+1}^{KK}\pi_{j+1})/(1 - \tau_{j+1}^{KK})] \quad (3.2)
\end{aligned}$$

Imposing a transversality condition ruling out eternal speculative bubbles:

$$\lim_{T\to\infty} S_T/\Pi_{j=1}^{T} [1 + (e_j + \tau_{j+1}^{KK} \pi_{j+1})/(1 - \tau_{j+1}^{KK})] = 0 \qquad (3.3)$$

yields:

$$\sum_{s=1}^{\infty} S_s/\Pi_{j=1}^{s-1} [1 + (e_j + \tau_{j+1}^{KK} \pi_{j+1})/(1 - \tau_{j+1}^{KK})]$$
$$- \sum_{s=1}^{\infty} S_{s+1}/\Pi_{j=1}^{s} [1 + (e_j + \tau_{j+1}^{KK} \pi_{j+1})/(1 - \tau_{j+1}^{KK})] = S_t \qquad (3.4)$$

Substituting (3.4) into (3.2):

$$S_t = \sum_{s=1}^{\infty} \{[(1 - \tau_{s+1}^{KD})/(1 - \tau_{s+1}^{KK})]D_s - \Delta S_{s+1}^{N}\}$$
$$/\Pi_{j=1}^{s} [1 + (e_j + \tau_{j+1}^{KK} \pi_{j+1})/(1 - \tau_{j+1}^{KK})] \qquad (3.5)$$

The after-personal tax return on equity may be defined as:

$$e_t \equiv (1 - \tau_{t+1}^{KE})\hat{e}_t = (1 - \tau_{t+1}^{KD})D_t/S_t$$
$$+ (1 - \tau_{t+1}^{KK})(S_{t+1} - S_t - \Delta S_{t+1}^{N})/S_t - \tau_{t+1}^{KK} \pi_{t+1} \qquad (3.6)$$

while the pre-personal tax return is:

$$\hat{e}_t \equiv D_t/S_t + (S_{t+1} - S_t - \Delta S_{t+1}^{N})/S_t \qquad (3.7)$$

thus:

$$1 - \tau_{t+1}^{KE} \equiv [(1 - \tau_{t+1}^{KD})D_t/S_t + (1 - \tau_{t+1}^{KK})(S_{t+1} - S_t - \Delta S_{t+1}^{N})/S_t - \tau_{t+1}^{KK} \pi_{t+1}]$$
$$/[D_{t+1}/S_t + (S_{t+1} - S_t - \Delta S_{t+1}^{N})/S_t] \qquad (3.8)$$

Equity value is maximized subject to technology, physical capital accumulation and installation cost constraints. The firm's technology is described by a constant returns to scale Cobb-Douglas production function:

$$Y_t = q_t L_t^{\alpha} K_t^{1-\alpha} \; ; \; 0 < \alpha < 1 \tag{3.9}$$

where trend total factor productivity and labour evolve according to:

$$q_t = (1 + g^q) q_{t-1} \tag{3.10}$$

$$L_t = (1 + g^L) L_{t-1} \tag{3.11}$$

and physical capital depreciates at a constant rate:

$$K_t = (1 - \delta) K_{t-1} + I_t \; ; \; 0 < \delta < 1 \tag{3.12}$$

Installation costs are assumed to be a quadratic function of the rate of investment:

$$\phi_t = \begin{cases} \dfrac{(\beta/2)(I_t/K_t - \theta)^2}{I_t/K_t} & ; \; I_t/K_t \geq \theta \\ 0 \; ; \; I_t/K_t < \theta \end{cases} \tag{3.13}$$

Dividends are the unretained portion of after-corporate tax earnings:

$$E_t \equiv R_t + D_t \tag{3.14}$$

After-corporate tax earnings are given by:

$$E_t = \hat{E}_t - \tau_t^{KC} [Y_t^K - r_{t-1}^C B_{t-1}^C / (1 + \pi_t)]$$
$$+ \tau_t^{KC} \delta_t^T K_{t-1}^T - \tau_t^{KC} \pi_t [\nu Y_t + (1 - \nu) Y_{t-1}](1 - \nu) \tag{3.15}$$

where τ^{KC} is the corporate income tax rate, δ^T is the rate of capital consumption allowance, v is an inventory valuation adjustment parameter and $\hat{E}$ is pre-corporate tax earnings:

$$\hat{E}_t = Y_t^K - \delta K_{t-1} - [(1 + r_{t-1}^C)/(1 + \pi_t) - 1]B_{t-1}^C \tag{3.16}$$

Pre-corporate-tax gross capital income, Y_t^K, is determined by:

$$Y_t^K = (1 - \alpha)Y_t \tag{3.17}$$

3.2 The Investment Decision

The approach to the solution of the investment problem taken here follows that of Summers (1981, 1985), which synthesizes the *q* theory of investment developed by Tobin (1969) and the adjustment cost framework of Lucas (1967). The optimal investment solution is:

$$I_t/K_t = \theta + Q_t/\beta \tag{3.18}$$

where tax-adjusted Q has the form:

$$Q_t = (S_t + B_t^C - Z_t)/K_t - 1 + \Gamma_t + z_t \tag{3.19}$$

Q is the percentage deviation of firm value from the replacement value of the capital stock, adjusted for capital consumption allowances and investment tax credits. The parameters θ and β are the same as those appearing in the quadratic capital installation cost function. When Q equals zero, which will be the case in the long run, the marginal product of capital will equal the user cost of capital. The existence of installation costs which increase more than proportionally with the rate of investment is the key to the partial adjustment feature of (3.18). The nominal capital consumption allowance base is determined by:

$$\tilde{K}_t^T = (1 - \delta_t^T)(\tilde{K}_{t-1}^T + P_{t-1}I_{t-1}) \tag{3.20}$$

where P is the price level and the real capital consumption allowance base is:

$$K_t^T = \tilde{K}_t^T / P_t \tag{3.21}$$

The present value of capital consumption allowances on existing capital is given by:

$$Z_t = [(1 - \delta_t^T)z_t + \tau_t^{KC} \delta_t^T] K_{t-1}^T \tag{3.22}$$

The investment decision carries with it a financing decision which is solved separately. The firm can finance investment by either retaining earnings (internal financing), R, or net debt issuance (external financing):

$$(1 - \Gamma_t + \phi_t) I_t = R_t + \Delta B_t^C \tag{3.23}$$

The financing mix is determined by the leverage decision, to which we now turn.

3.3 The Leverage Decision

Optimal leverage is determined by equating the marginal cost of corporate debt with its marginal tax advantage. At the optimal leverage the firm minimizes the after-corporate tax cost of funds it faces, and maximizes firm value.

The deductibility of corporate interest payments at a rate exceeding the personal tax rate creates a debt financing tax advantage which causes the cost of funds to fall and firm value to rise as leverage increases from initially very low levels. As leverage continues to rise, however, leverage-related costs increasingly offset the tax benefit. Leverage costs stem from the possibility of bankruptcy and reorganization and the separability of corporate ownership and control. Bankruptcy and liquidation are not costless, but generally involve an adjudication process which consumes a fraction of the remaining value of the assets of the firm. As leverage rises, the probability of default increases, raising the default risk premium on corporate debt.

Jensen and Meckling (1976) argue that agency costs are another significant source of leverage costs. Firm ownership and control separability implies that equity and bondholders must rely upon managers, who may have a small ownership stake in the firm, to act as their agents. These agents have their own objectives which may not coincide with those of shareholders and bondholders. An increase in leverage can have perverse incentive effects upon agent investment decision behaviour. At a high leverage, agent-managers will have a strong incentive to make investments which promise a very high payoff if successful even if they have a very low probability of success. If successful, the agent will capture most of the gains as a return on her own equity, while if unsuccessful,

the bondholders will bear most of the costs. Potential purchasers of a new bond float will recognize this leverage-agent incentive relationship and accordingly demand an increased risk premium at higher leverages.

DeAngelo and Masulis (1980) argue that higher leverage lowers the probability that corporate tax shield substitutes such as accounting depreciation deductions and investment tax credits will be fully usable in low earnings states of the world. This represents another positive effective marginal cost of debt which can interact with the net tax advantage of debt to generate an interior leverage optimum.

Assuming that corporate leverage is b ($b \equiv B^C/(S + B^C)$) and that all government bonds are held by the non-equity holding households, then (2.9) and (2.10) combined with the equilibrium condition $b_t = b_t$ imply:

$$\hat{e}_t = [r_t^G (1 - \tau_t^{KB}) - \pi_t]/(1 - \tau_t^{KE}) + (1 - b_t)(1 - \tau_t^{KE})(\sigma_t^E)^2(1 - \xi) \tag{3.24}$$

$$r_t^C = r_t^G + (1 - \tau_t^{KB})b_t(\sigma_t^{BC})^2(1 - \xi) \tag{3.25}$$

The relationships of the variances of the returns on corporate debt and equity to the variance of the total capital return are modelled as:

$$(\sigma^{BC})^2 = \lambda\Psi(b)(1 - \tau_t^{KC})^2\sigma^2/b^2 \tag{3.26}$$

$$(\sigma^E)^2 = [1 - \Psi(b)](1 - \tau_t^{KC})^2\sigma^2/(1 - b)^2 \tag{3.27}$$

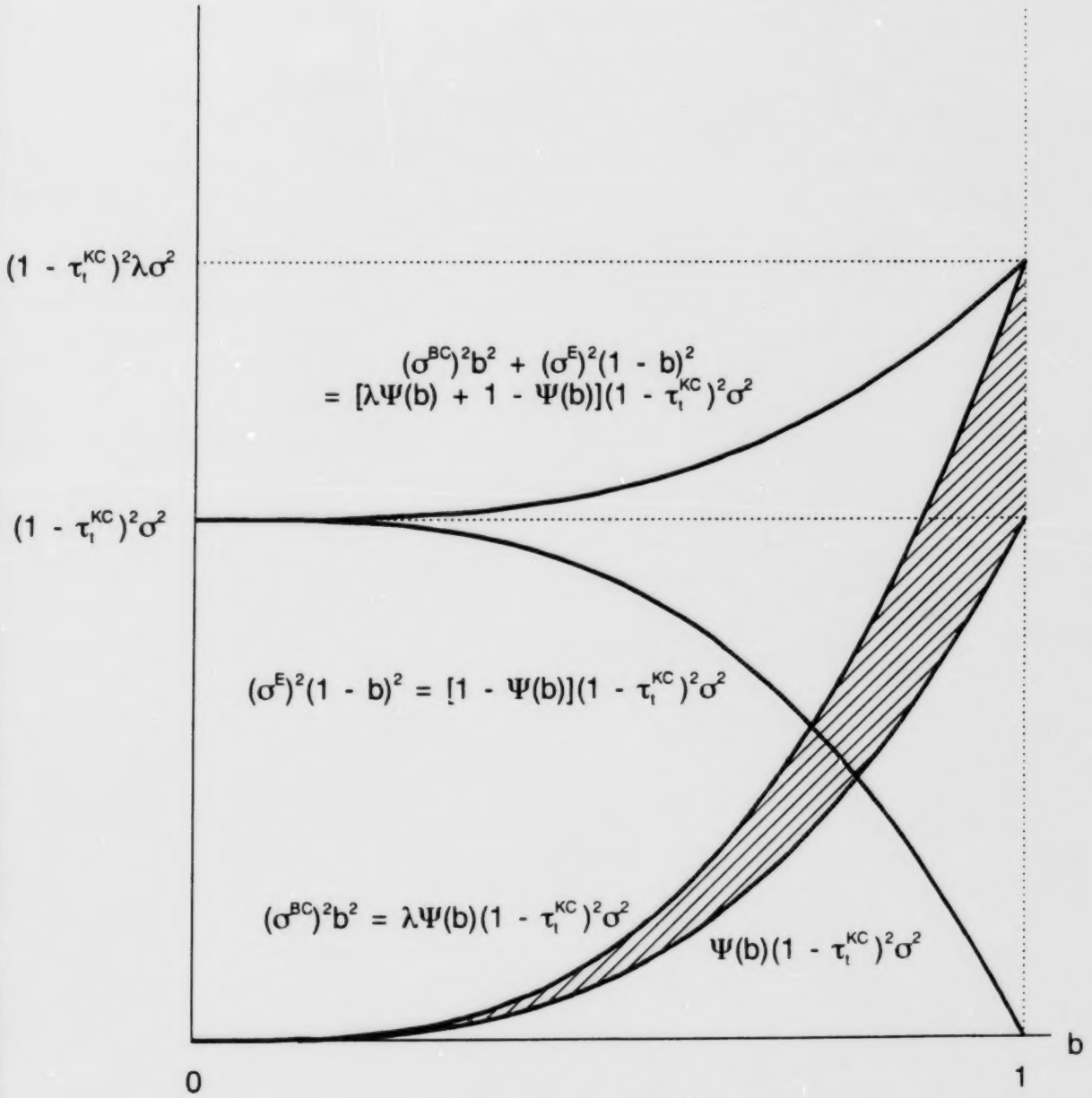
where:

$$\Psi'(b) \geq 0,\ \Psi''(b) \geq 0,\ \Psi(0) = 0,\ \Psi(1) = 1,\ \lim_{b\to 0} \Psi(b)/b^2 = 0 \tag{3.28}$$

and $\lambda - 1$ is a measure of bankruptcy cost ($\lambda \geq 1$). The specific form of Ψ assumed is:

$$\Psi_t = \begin{cases} b_t^{\mu} - \bar{b}\ ;\ b_t^{\mu} \geq \bar{b}\ ;\ \mu > 1 \\ 0\ ;\ b_t^{\mu} < \bar{b} \end{cases} \tag{3.29}$$

Debt, Equity and Total Capital Return Variances



The qualifications given in section 2.1 should be kept in mind in interpreting (3.26) and (3.27). Substituting (3.26) and (3.27) into (3.24) and (3.25):

$$\hat{e}_t = [r_t^G (1 - \tau_t^{KB}) - \pi_t]/(1 - \tau_t^{KE})$$

$$+ (1 - \xi)\sigma_t^2 (1 - \tau_t^{KE})^2(1 - \tau_t^{KC})^2[1 - \Psi(b_t)]/(1 - b_t) \tag{3.30}$$

$$r_t^c = r_t^G + (1 - \xi)\sigma_t^2 \tag{3.31}$$

$$\{[r_t^c (1 - \tau_t^{KB}) - \pi_t]/(r_t^c - \pi_t)\}^2\lambda(1 - \tau_t^{KC})^2[\Psi(b_t)/b_t]/(1 - \tau_t^{KB})$$

The real cost of funds is:

$$\gamma_t = b_t[r_t^c (1 - \tau_t^{KC}) - \pi_t] + (1 - b_t)\hat{e}_t \tag{3.32}$$

Substituting (3.30) and (3.31) into (3.32):

$$\gamma_t = b_t[\{r_t^G + (1 - \xi)\sigma_t^2 + \{[r_t^c (1 - \tau_t^{KB}) - \pi_t]/(r_t^c - \pi_t)\}^2$$

$$\lambda(1 - \tau^{KC})^2[\Psi(b_t)/b_t]/(1 - \tau_t^{KB})\}(1 - \tau_t^c) - \pi_t]$$

$$+ (1 - b_t)\{[r_t^G (1 - \tau_t^{KB}) - \pi_t]/(1 - \tau_t^{KE})$$

$$+ (1 - \xi)\sigma_t^2 (1 - \tau_t^{KE})^2(1 - \tau_t^{KC})^2[1 - \Psi(b_t)]/(1 - b_t)\} \tag{3.33}$$

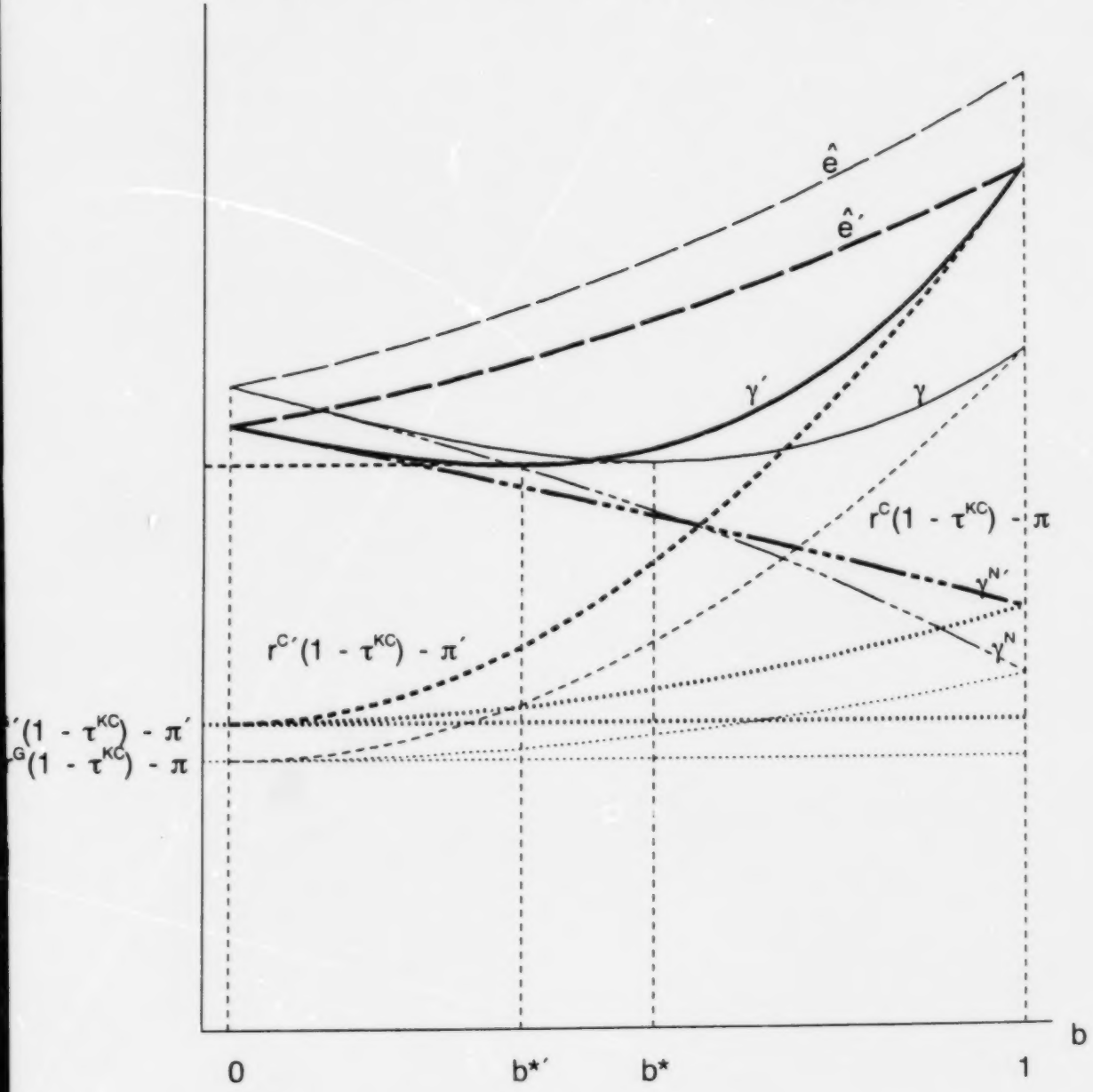
In the absence of taxes and bankruptcy costs this reduces to:

$$\gamma_t = r_t^G - \pi_t + (1 - \xi)\sigma_t^2 \tag{3.34}$$

in which case leverage is irrelevant and the Modigliani-Miller theorem holds. Minimizing the real cost of funds with respect to leverage yields the first-order condition:

$$\Psi'(b_t) = \frac{\dfrac{r_t^G (1 - \tau_t^{KB}) - \pi_t}{1 - \tau_t^{KE}} - [r_t^G (1 - \tau_t^{KC}) - \pi_t]}{[\left(\dfrac{(1 - \tau_t^{KB})r_t^c - \pi_t}{r_t^c - \pi_t}\right)^2 \lambda \dfrac{1 - \tau_t^{KC}}{1 - \tau_t^{KB}} - (1 - \tau_t^{KE})]\sigma_t^2 (1 - \tau_t^{KC})^2(1 - \xi)} \tag{3.35}$$

Impact of an Inflation Reduction on Rates of Return and Optimal Leverage



The stochastic portion of government capital tax revenue is assumed to be offset by the application of stochastic lump-sum capital taxes and transfers. This is modelled by a choice of h = 1 in:

$$h\hat{\sigma}_t^2 [(1 - b_t)(1 - \Psi_t) + b_t\lambda\Psi_t] = [\sigma_t^2 - (1 - h)\tilde{\sigma}_t^2](1 - \tau_{t+1}^{KC})^2$$

$$\bullet[(1 - b_t)(1 - \tau_{t+1}^{KF})^2(1 - \Psi_t) + b_t(\frac{r_t^c (1 - \tau_{t+1}^{KB}) - \pi_{t+1}}{r_t^c - \pi_{t+1}})^2\lambda\Psi_t] \qquad (3.36)$$

where $\hat{\sigma}_t^2$ and $\tilde{\sigma}^2$ are given. This implies that higher capital tax rates do not ultimately provide insurance against capital return risk. A choice of h = 0 would imply a complete insurance capability for capital taxation, as described by Gordon (1985).

3.4 The Labour Input Decision

The firm chooses the level of labour input in order to equate the marginal product of labour with the real wage, which it takes as given. Since leisure is not included in the utility function in the initial version of the model, labour supply will be inelastic with respect to the real wage. Labour supply will be determined by exogenous variables such as the population, its age structure and participation rate patterns.

3.5 The Output Decision

The investment decision generates the capital stock, and this combined with the labour input, determines output via the production technology. Technological progress and population growth are exogenous.

3.6 Government Behaviour

The government chooses levels of tax rates, government indebtedness and inflation. It faces the discrete time asset accumulation condition:

$$B_{s+1}^G = (1 + i_s^G)(B_s^G + G_s^A + R_s - T_s) \qquad (2.8)$$

where B^G is the stock of government bonds outstanding, i^G is the real after-personal tax return on government bonds received at the end of the period, G^A is government absorption, R is transfers and T is taxes applied at the beginning of the period. Government absorption is assumed to be equal to government output, thus the government's net contribution to society's consumption possibilities is zero.

Household enforcement of a transversality condition upon private and government issuers of assets means that the government may not permanently issue bonds at a rate faster than the return i^G. Steady-state stability of the government debt-to-output ratio ensures that this condition is satisfied, which implies that the primary balance-to-output ratio must asymptotically satisfy:

$$(T - G^{\wedge} - R)/Y = [(i^G - g)/(1 + i^G)]B^G/Y \tag{2.9}$$

where g is the steady-state output growth rate. If $g < i^G$, it follows that a positive steady-state debt-to-GDP ratio requires steady-state primary surpluses.

Revenue changes arising from any statutory tax change or inflation-capital tax interaction are assumed to be offset by an adjustment to lump-sum taxes and transfers sufficient to keep the stock of government debt at its control path.

4 Equilibrium

The intratemporal equilibrium conditions are that given expectations, aggregate supplies and demands are equal at each point in time. Expectations must conform to the actual values realized in later periods. The goods and labour markets clear, and firm financial structure is consistent with household portfolio choice.

Perfect foresight expectations of the trend values of variables are obtained using a variant of the Fair-Taylor extended path algorithm. The method is described in Fair and Taylor (1983) and Fair (1984). In each "inner level" iteration, the model is solved for some number of periods greater than the maximum lead on any endogenous variable. The new values for the future solutions are compared to those from the previous inner level iteration, and the process is repeated until they converge. In each "outer level" iteration, the horizon over which the model is solved through the inner level iterations is increased by one period. When the inner level iterations have converged, the new valued for the leads required to solve the current period are compared with those from the previous outer level iteration, and the process is repeated until they converge. Initial guesses for the leads are required to begin the simulation process. These are obtained by first solving a steady-state analogue of the dynamic model. In the steady-state model, recursive relationships such as those for the propensities to consume:

$$(m_t^{\wedge})^{-1} = 1 + (m_{t+1}^{\wedge})^{-1} (1 + \hat{r}_t^{\wedge})^{\xi(1-\xi)}/(1 + \rho)^{1(1-\xi)} \tag{4.1}$$

are written in their steady-state form:

$$m_t^{\wedge} = 1 - (1 + \hat{r}_t^{\wedge})^{\xi(1-\xi)}/(1 + \rho)^{1(1-\xi)} \tag{4.2}$$

The steady-state capital stock is obtained by solving (3.9)-(3.12) under steady-state growth assumptions:

$$\Delta\ln(Y_t) = \Delta\ln(q_t) + \alpha\Delta\ln(L_t) + (1 - \alpha)\Delta\ln(K_t) \tag{4.3}$$

$$\therefore \quad \Delta\ln(Y_t) = g^q + \alpha g^L + (1 - \alpha)\Delta\ln(K_t) \tag{4.4}$$

$$\therefore \quad \alpha\Delta\ln(Y_t) = g^q + \alpha g^L \tag{4.5}$$

$$\therefore \quad \Delta\ln(Y_t) = g^q/\alpha + g^L \equiv g \tag{4.6}$$

$$\therefore \quad K_t = (1 + g)I_t/(g + \delta) \tag{4.7}$$

The parameters θ and β in the quadratic capital installation cost function are constrained to ensure that when Q equals zero in (3.18), (4.7) will be satisfied.

The discrete time recursive analogues to (2.17) and (2.19):

$$W_t^K = Y_t^K - \delta K_{t-1} + W_{t+1}^K/(1 + \gamma_t^{KAP}) \tag{4.8}$$

$$W_t^L = Y_t^L + W_{t+1}^L(1 + \pi_{t+1})/\{[1 + r_t^{GD}(1 - \tau_t^{KB})](1 + \omega_t)\} \tag{4.9}$$

appear in the steady-state model as:

$$W_t^K = [Y_t^K - \delta K_t/(1 + g)](1 + \gamma_t^{KAP})/(\gamma_t^{KAP} - g) \tag{4.10}$$

$$W_t^L = Y_t^L\{[1 + r_t^{GD}(1 - \tau_t^{KB})](1 + \omega_t)/(1 + \pi_{t+1})\}$$
$$/\{[1 + r_t^{GD}(1 - \tau_t^{KB})](1 + \omega_t)/(1 + \pi_{t+1}) - 1 - g\} \tag{4.11}$$

5 Simulation Results

5.1 The Control Simulation

The steady-state version of the model has been loosely calibrated to a 1991 Canadian benchmark. Table 5.1 gives the benchmark control values of the key income, expenditure and wealth variables, while Table 5.2 gives the control values of the tax rate and exogenous variables and principle calibration parameters.

The level of aggregation is the commercial sector, which is similar to Statistics Canada's concept of the business sector. Commercial sector output at factor cost is obtained by subtracting consumer expenditures for rent, total government wage expenditures, and capital consumption allowances for the federal, provincial, municipal and hospital sectors from gross domestic product at factor cost, which is equal to GDP at market prices net of indirect taxes and subsidies. Consumption and investment data is based upon the system of national accounts. Government absorption is assumed equal to the production of the government good.

The market value of equity is calculated by dividing the Industrial Corporations Financial Statistics dividend series by the TSE dividend-price ratio. The value of equity is then multiplied by the TSE earnings-price ratio to obtain a TSE-consistent earnings series. The market value of debt is calculated by dividing Industrial Corporations Financial Statistics interest payments on short and long term debt series by the 90 day commercial paper and long corporate bond rates, respectively.

Personal capital tax rates are average combined federal and provincial marginal tax rates of recipients by capital income type weighted by income class. The capital gains tax rate is adjusted to place it on an accruals basis. The pre-personal tax equity return is based upon the TSE earnings-price ratio, the corporate bond rate upon the 90 day commercial paper rate and the government bond rate upon the 90 day treasury bill rate.

The capital stock is the end-of-year net stock in all industries less the stock of the federal, provincial and municipal governments, hospitals, and schools. The depreciation rate is imputed from Statistics Canada's Fixed Capital Flows and Stocks investment data.

The labour input is measured as total hours worked in the commercial sector. This series is obtained from unpublished data constructed by Statistics Canada using Labour Force Survey (LFS) data.

In the steady state, the trend income, expenditure and wealth variables grow at a rate of 3 per cent per year. This follows from the production function and the employment and trend total factor productivity growth rates, and implies a constant capital-labour ratio when labour is measured in efficiency units.

Table 5.1
Key Income, Expenditure, and Wealth Variables
Steady-State 1991 Control Values
(billions of 1986 dollars)

Variable	Benchmark
Commercial Output	401.7
Consumption by Equity-Holding Households	27.5
Consumption by Non-Equity Holding Households	296.2
Consumption	323.7
Investment	78.0
Capital Stock	803.4
Wealth of Equity-Holding Households	741.5
Wealth of Non-Equity-Holding Households	9051.9
Wealth	9793.4
Human Capital Wealth	7833.4
Physical Capital Wealth	1960.0
Corporate Debt	198.3
Equity	563.2
CCA Base	450.1

Table 5.2
Control Values of Tax Rate and Exogenous Variables
and Principle Calibration Parameters

Variable	Value
Inflation Rate (per cent)	4.00
Employment Growth (per cent)	1.40
Trend Total Factor Productivity Growth (per cent)	1.00
Labour Income Share	0.64
Corporate Income Tax Rate	0.36
Capital Gains Tax Rate (Accruals Basis)	0.07
Dividend Tax Rate	0.28
Interest Income Tax Rate	0.27
Investment Tax Credit Rate	0.01
Capital Consumption Allowance Rate	0.09
Economic Depreciation Rate	0.07
Intertemporal Elasticity of Substitution	0.50
Rate of Time Preference (per cent)	3.08
Pre-Tax Capital Return Variance (per cent)	3.60
$\bar{b}$	0.008
μ	10.00
β	10.00
θ	0.10

5.2 A Permanent 1 Percentage Point Reduction in Inflation

5.2.1 Steady-State Results

We turn first to a shock consisting of a permanent 1 percentage point decrease in the rate of inflation from 4 to 3 per cent. Tables 5.3 and 5.4 give the steady-state impacts upon trend income, expenditure, wealth, rates of return and asset position variables. It can be seen that reduced inflation has a substantial positive impact upon the steady-state capital stock. Output, consumption, equity and firm values and equity-holding-household wealth and welfare are also significantly higher, while leverage, the user cost of capital and the pre-corporate tax real cost of funds, and equity and bond returns are lower.

Table 5.3
Steady-State Impact of a Permanent 1 Point Decrease in Inflation
On Key Income, Expenditure and Wealth Variables
(Per Cent Shock Minus Control)

Variable	Change
Commercial Output	1.07
Consumption by Equity-Holding Households	2.91
Consumption by Non-Equity-Holding Households	0.39
Consumption	0.61
Investment	2.97
Capital Stock	2.97
Wealth of Equity-Holding Households	3.14
Wealth of Non-Equity-Holding Households	0.18
Wealth	0.40
Human Wealth	0.64
Capital Wealth *	-0.53
Net Capital Income *	-0.07
Corporate Debt	-4.44
Equity	5.90
Firm Value	3.14
CCA Base	10.14
Welfare of Equity-Holding Households	2.62
Welfare of Non-Equity-Holding Households	0.61

* Pre-corporate tax and credit

Real after-tax corporate bond returns are slightly lower, while the real after-personal-tax government bond return is unchanged. These results can be interpreted and understood by examining the model channels through which inflation affects other variables. The nonneutral effects of inflation in the model arise chiefly from its impact on the distorting tax wedges which exist between the returns on capital paid by firms and the returns received by households.

Table 5.4
Steady-State Impact of a Permanent 1 Point Decrease in Inflation
On Key Rate of Return, and Asset Position Variables
Control and Shock Values and Percentage Point Change

Variable	Control	Shock	Change
User Cost (1)	18.15	17.81	-0.33
Marginal Product of Capital	18.15	17.81	-0.33
Real Cost of Funds (1)	12.30	11.92	-0.38
Real Cost of Funds (2)	6.87	6.81	-0.06
Real Cost of Funds (3)	5.59	5.54	-0.05
Return on Equity (1)	15.57	14.75	-0.82
Return on Equity (2)	8.16	7.96	-0.20
Return on Equity (3)	6.04	5.99	-0.06
Real Corporate Rate (1) *	7.39	6.81	-0.57
Real Corporate Bond Rate (2)	3.34	3.31	-0.03
Real Corporate Bond Rate (3)	4.35	4.19	-0.17
Real Government Rate (1) *	6.47	6.15	-0.32
Real Government Bond Rate (3)	3.69	3.70	0.02
Real Cost of Funds Premium (3)	1.84	1.77	-0.07
Equity Premium (3)	2.27	2.20	-0.07
Corporate Bond Premium (3)	0.64	0.47	-0.18
Cons./Wealth: Equity-Holders	3.71	3.70	-0.02
Cons./Wealth: Non-Equity-Holders	3.27	3.28	0.02
Leverage	26.74	24.78	-1.97
Total Savings Rate	19.41	19.78	0.36

(1) Pre-corporate tax (2) After-corporate tax (3) After-personal tax * Fisher real rates

The reduction in inflation lowers the marginal tax advantage of debt which exists because firms may deduct interest payments at a corporate tax rate exceeding the personal tax rate on interest income. The base, however, for both corporate interest deductions and personal tax is nominal interest paid. A lowering of the inflation component of the tax and deduction base therefore reduces the net tax advantage derived from debt financing. The decrease in the marginal tax advantage of debt causes leverage to fall, which decreases deadweight bankruptcy and other leverage costs and leads to a lowering of corporate debt risk premia. The reduction in the deadweight portion of capital return risk causes real after tax safe government bond rates to rise. Table 5.5 shows that reduced inflation leads to a pronounced decrease in the corporate equity wedge (the largest, in absolute terms, of all the wedge changes) and a small decrease in the personal equity wedge. Significant contributors to the decrease in the corporate equity wedge are a reduced nominal inventory valuation component and a substantially higher steady-state real capital consumption allowance base. The personal debt wedge falls, but this is slightly more than offset by an increase in the corporate debt wedge. The total equity wedge thus falls substantially, while the total debt wedge increases slightly. The personal wedge is unchanged, while the

Table 5.5
Steady-State Impact of a Permanent 1 Point Decrease in Inflation
On Tax Wedge Levels, Contributions and Effective Tax Rates
Control and Shock Values and Percentage Point Change

Variable		Control	Shock	Change
Tax Wedge Levels:				
Equity Wedge - Personal	∇^{EP}	2.12	1.97	-0.14
Equity Wedge - Corporate	∇^{EC}	7.41	6.79	-0.62
Debt Wedge - Personal	∇^{BP}	3.03	2.63	-0.41
Debt Wedge - Corporate	∇^{BC}	-4.04	-3.50	0.54
Debt Wedge - Total	∇^{BT}	-1.01	-0.88	0.14
Equity Wedge - Total	∇^{ET}	9.53	8.77	-0.76
Capital Wedge - Personal	∇^{KP}	1.28	1.99	-0.01
Capital Wedge - Corporate	∇^{KC}	5.43	4.39	-0.32
Capital Wedge - Total	∇^{KT}	6.71	6.38	-0.33
Tax Wedge Contributions:				
Equity Wedge - Personal	$\hat{\nabla}^{EP}$	1.55	1.97	-0.07
Equity Wedge - Corporate	$\hat{\nabla}^{EC}$	5.43	6.79	-0.32
Debt Wedge - Personal	$\hat{\nabla}^{BP}$	0.81	2.63	-0.16
Debt Wedge - Corporate	$\hat{\nabla}^{BC}$	-1.08	-3.50	0.21
Debt Wedge	$\hat{\nabla}^{BT}$	-0.27	-0.88	0.05
Equity Wedge	$\hat{\nabla}^{ET}$	6.98	8.77	-0.38
Effective Tax Rates:				
Equity - Personal	$\hat{\tau}^{EP}$	0.259	0.248	-0.011
Equity - Corporate	$\hat{\tau}^{EC}$	0.526	0.499	-0.027
Debt - Personal	$\hat{\tau}^{BP}$	0.411	0.385	-0.026
Debt - Corporate	$\hat{\tau}^{BC}$	-0.187	-0.154	0.033
Debt - Total	$\hat{\tau}^{BT}$	0.300	0.291	-0.009
Equity - Total	$\hat{\tau}^{ET}$	0.649	0.624	-0.025
Capital - Personal	$\hat{\tau}^{KP}$	0.300	0.282	-0.018
Capital - Corporate	$\hat{\tau}^{KC}$	0.335	0.337	0.002
Capital - Total	$\hat{\tau}^{KT}$	0.534	0.524	-0.010

corporate and total wedges fall. The reduction in inflation from 4 to 3 per cent reduces the total effective tax rate on capital from 53.4 to 52.4 per cent.

The wedges are defined as the differences between before and after-tax rates of return:

$$\nabla_t^{EP} \equiv E_t/S_t - e_t \tag{5.1}$$

$$\nabla_t^{EC} \equiv \{Y_t^K - \delta K_{t-1} - \{[1 + r_t^c (1 - \tau_{t+1}^{KC})]/(1 + \pi_{t+1}) - 1\}B_t^c\}/S_t - E_t/S_t \tag{5.2}$$

$$\nabla_t^{BP} \equiv (1 + r_t^c)/(1 + \pi_{t+1}) - [1 + r_t^c (1 - \tau_{t+1}^{KB})]/(1 + \pi_{t+1}) \tag{5.3}$$

$$\nabla_t^{BC} \equiv [1 + r_t^c (1 - \tau_{t+1}^{KC})]/(1 + \pi_{t+1}) - (1 + r_t^c)/(1 + \pi_{t+1}) \tag{5.4}$$

$$\nabla_t^{BT} \equiv \nabla_t^{BP} + \nabla_t^{BC} \tag{5.5}$$

$$\nabla_t^{ET} \equiv \nabla_t^{EP} + \nabla_t^{EC} \tag{5.6}$$

$$\nabla_t^{KP} \equiv \{E_t + \{[1 + r_t^c (1 - \tau_{t+1}^{KC})]/(1 + \pi_{t+1}) - 1\}B_t^c\}/(S_t + B_t)$$
$$- b_t\{[1 + r_t^c (1 - \tau_{t+1}^{KB})]/(1 + \pi_{t+1}) - 1\} - (1 - b_t)e_t \tag{5.7}$$

$$\nabla_t^{KC} \equiv (Y_t^K - \delta K_{t-1})/(S_t + B_t) - \gamma_t \tag{5.8}$$

$$\nabla_t^{KT} \equiv \nabla_t^{KP} + \nabla_t^{KC} \tag{5.9}$$

While the wedge contributions are given by:

$$\hat{\nabla}_t^{EP} \equiv (1 - b_t)\nabla_t^{EP} \tag{5.10}$$

$$\hat{\nabla}_t^{EC} \equiv (1 - b_t)\nabla_t^{EC} \tag{5.11}$$

$$\hat{\nabla}_t^{BP} \equiv b_t\nabla_t^{BP} \tag{5.12}$$

$$\hat{\nabla}_t^{BC} \equiv b_t\nabla_t^{BC} \tag{5.13}$$

$$\hat{\nabla}_t^{BT} \equiv b_t \nabla_t^{BT} \tag{5.14}$$

$$\hat{\nabla}_t^{ET} \equiv (1 - b_t)\nabla_t^{ET} \tag{5.15}$$

and the effective tax rates by:

$$\hat{\tau}_t^{EP} \equiv \nabla_t^{EP} / (E_t / S_t) \tag{5.16}$$

$$\begin{aligned}\hat{\tau}_t^{EC} \equiv & \{\tau_t^{KC} [Y_t^K - r_{t-1}^C B_{t-1}^C / (1 + \pi_t)] \\ & + \tau_t^{KC} \delta_t^T K_{t-1}^T - \tau_t^{KC} \pi_t [vY_t + (1 - v)Y_{t-1}](1 - v)\} \\ & / \{Y_t^K - \delta K_{t-1} - [(r_t^C - \pi_{t+1})/(1 + \pi_{t+1})]B_t^C\}\end{aligned} \tag{5.17}$$

$$\hat{\tau}_t^{BP} \equiv \nabla_t^{BP} / [(1 + r_t^C)/(1 + \pi_{t+1}) - 1] \tag{5.18}$$

$$\hat{\tau}_t^{BC} \equiv - \tau_{t+1}^{KC} \pi_{t+1} / (r_t^C - \pi_{t+1}) \tag{5.19}$$

$$\hat{\tau}_t^{BT} \equiv 1 - (1 - \hat{\tau}_t^{BP})(1 - \hat{\tau}_t^{BC}) \tag{5.20}$$

$$\hat{\tau}_t^{ET} \equiv 1 - (1 - \hat{\tau}_t^{EP})(1 - \hat{\tau}_t^{EC}) \tag{5.21}$$

$$\hat{\tau}_t^{KP} \equiv b_t \hat{\tau}_t^{BP} + (1 - b_t)\hat{\tau}_t^{EP} \tag{5.22}$$

$$\hat{\tau}_t^{KC} \equiv b_t \hat{\tau}_t^{BC} + (1 - b_t)\hat{\tau}_t^{EC} \tag{5.23}$$

$$\hat{\tau}_t^{KT} \equiv 1 - (1 - \hat{\tau}_t^{KEP})(1 - \hat{\tau}_t^{KEC}) \tag{5.24}$$

The decline in the equity wedge is concentrated on the corporate side, as lower inflation reduces the nominal inventory valuation component of the corporate tax base and raises the capital consumption allowance (CCA) base. The latter effect occurs because the CCA base is calculated at purchase rather than replacement price. A sustained reduction in inflation therefore raises the CCA base closer to the replacement value of the capital stock, allowing greater CCA deductions from capital income and a decrease in corporate tax payable. The

total debt wedge is less negative, owing to the deductibility of nominal interest payments at a corporate tax rate exceeding the personal tax rate on nominal interest income.

The lowering of the capital tax wedges and the effective rate of corporate tax decreases the user cost of capital and generates a higher desired capital stock. Attaining the higher capital stock requires a period of capital accumulation and adjustment. To understand the dynamics of this process we now turn to the transition path simulation.

The results that capital wealth is lower while firm value is higher can be reconciled by recognizing that physical capital wealth equals the sum of firm value and the present value of future capital taxes net of investment tax credits and lump-sum transfers to corporations. Physical capital wealth is the present value of the stream of pre-tax-and-transfer capital income net of depreciation, while firm value is the present value of after-tax capital income. A constant gross capital income share implies that pre-tax gross capital income, will, like output, be 1.07 per cent higher in the steady state as a consequence of the inflation reduction. The higher depreciation charges stemming from the significantly higher steady-state capital stock, however, cause net pre-tax capital income to actually fall by 0.04 per cent. This, combined with an unchanged steady-state pre-tax capital income discount rate leads to lower capital wealth. Firm value is higher because the total capital tax collected is lower and after-tax capital income is thus greater.

5.2.2 The Transition Path

The results of the fully dynamic permanent one point inflation reduction simulation are displayed in Charts 5.1 to 5.5 (following Section 6) and in the Appendix in Tables A.1 to A.8. The simulation is conducted over a period of 145 years to ensure that all of the variables have reached their new steady states by the simulation's terminal date. The new steady state is approached well before this, with half the output adjustment occurring approximately every 14 years.

The reduction in inflation causes trend values of capital costs, premia and tax wedges to immediately fall. An average decline in the user cost of capital of 0.26 per cent over the first five years causes investment to average close to 1.6 per cent above control over the same period. Output responds more slowly because a sustained period of higher investment is needed to significantly augment the capital stock. Since output is initially only slightly higher, the increased investment must come at the expense of lower consumption, which is down by an average of 0.20 per cent relative to control in the first 5 years. By the tenth year, however, the capital stock and the output it generates are sufficiently elevated to allow consumption to begin to rise above control. Reduced tax wedges and risk premia lead to small increases in real after-personal tax capital returns. An increase in the rate of return profile causes the propensities to consume out of wealth to rise since the intertemporal elasticity of substitution is less than 1, and the income effect thus dominates the intertemporal substitution effect. Consumption, however, must initially decline in order to permit the increased investment which is required to raise the capital stock. This is achieved through initially reduced non-equity-holder wealth. Ultimately higher consumption profiles combined with reduced risk premia raise the welfare of both types of agents, particularly equity-holders.

5.3 Temporary 1 Percentage Point Reductions in Inflation

Charts 5.6 to 5.19 compare the transition paths generated from simulations of temporary 1 point inflation reductions with a permanent 1 point reduction. A temporary reduction in inflation naturally has no steady-state impact, however the initial effects also tend to be quite small. A temporary 4 year reduction in inflation of 1 percentage point has virtually no effect on output, expenditure and wealth variables, even during the period of lower inflation. Initial welfare of the equity-holding agent is unchanged, while that of the non-equity-holding agent is slightly higher. Temporary 8 and 16 year 1 percentage point inflation reductions have larger effects on output and expenditure variables, although still much less than a permanent reduction. The initial welfare of the equity-holding agent is higher, while that of the non-equity-holding agent is actually lower than in the control case. This occurs because 8 and 16 year reductions in inflation generate sufficient additional after-personal-tax corporate debt and equity return income to the equity-holding households to raise their wealth and consumption for a period lasting beyond the inflation reduction. This, combined with initially higher investment demand implies a fall in non-equity-holding household consumption and wealth. The latter occurs because, although labour income is eventually temporarily slightly higher, the real after-personal tax safe rate is also higher, and its increase occurs immediately as a result of the initial wedge and risk premium declines. A temporary 24 year inflation reduction is sufficiently long to produce a small increase in initial non-equity-holding household welfare, while a temporary 32 year inflation reduction raises initial non-equity-holding household welfare by almost as much as a permanent inflation reduction. Equity-holding household welfare is higher for all the reduction lengths considered.

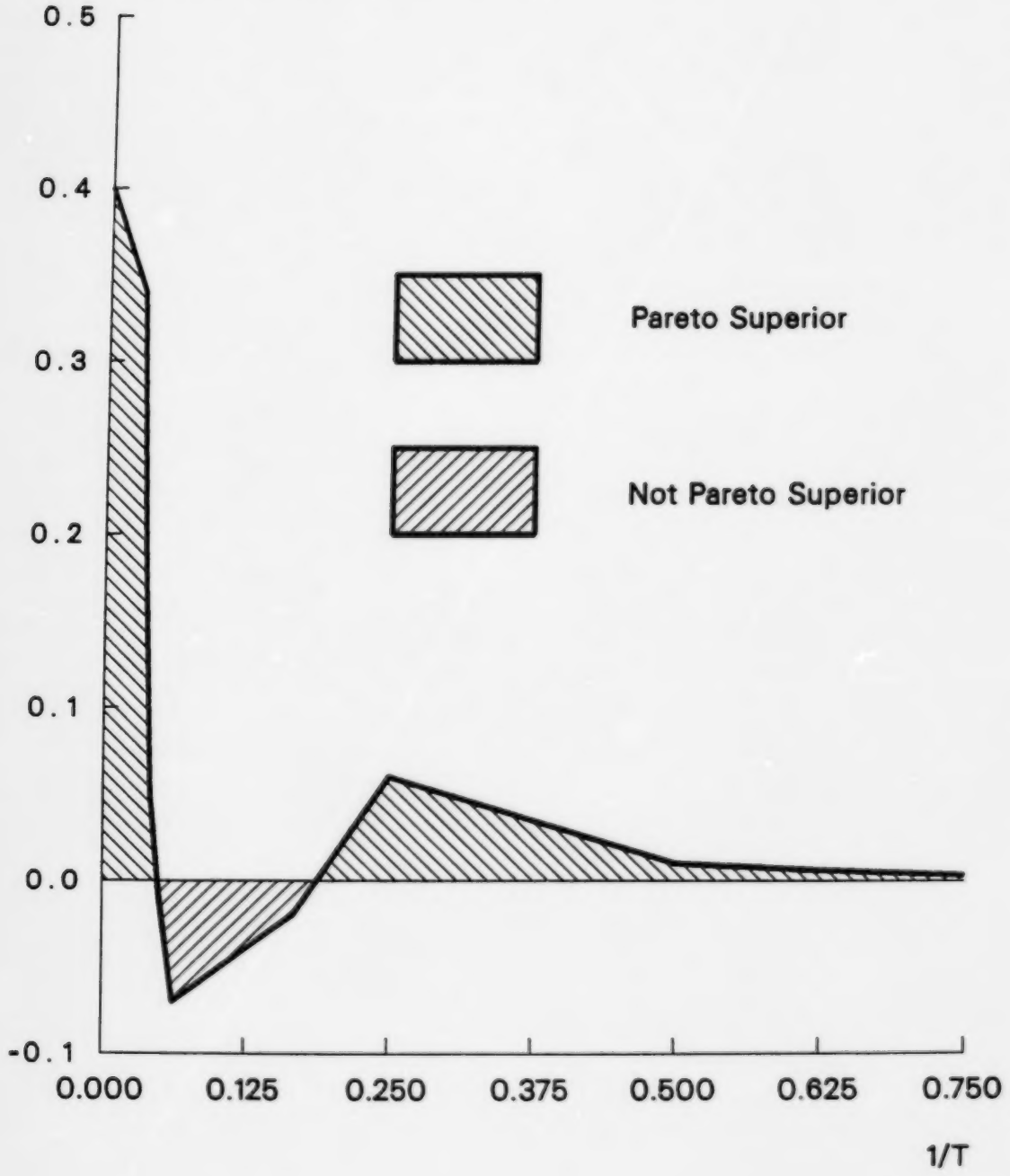
It follows while short and long anticipated inflation reductions can lead to a Pareto improvement, there can exist an intermediate length of anticipated reduction which makes the equity-holding household better off but the non-equity-holding household worse off. This result is summarized in Figure 5.1, which suggests that a Pareto improvement is not obtained from anticipated temporary inflation reductions lasting between 6 and 20 years. Social welfare may, nevertheless, be higher for temporary reductions of any length over a wide range of agent weightings.

5.4 Permanent, but Delayed, 1 Percentage Point Reductions in Inflation

In contrast to the temporary reductions in inflation, permanent, but delayed reductions have significant effects, even when the delay is as long as 16 years. Charts 5.20 to 5.29 compare the transition paths generated from simulations of permanent but delayed 1 point inflation reductions with an immediate permanent 1 point reduction. A 4 year delay generates transition paths for most variables close to those obtained in the immediate inflation reduction scenario. A 16 year delay leads to a smaller initial response, however, significant adjustment still occurs over the period preceding the decline. The immediate, 4, 8 and 16 year-delayed inflation reductions all generate similar initial wealth effects for non-equity-holding households, however, the initial welfare gain of equity-holders is significantly reduced by a substantial delay in the inflation reduction.

Figure 5.1
Initial Welfare Gain of Non-Equity-Holding Households From a 1 Point Inflation Reduction Lasting T Periods

Per Cent Shock Minus Control



5.5 Sensitivity to Alternative Assumptions

Table 5.6 provides the steady-state impacts of a permanent 1 point decrease in inflation under alternative assumptions regarding the endogeneity of leverage and the existence of an insurance role for capital taxation. The results are quite robust across these alternative assumptions. The first column shows again the steady-state base case impacts. The second column reports the results holding leverage fixed with the same control value inflation (4 per cent) as in the base case. The steady-state impacts are only slightly smaller than in the endogenous leverage simulation, however, the estimated gain obtained from endogenous leverage increases relative to a fixed leverage scenario as the level of the control scenario inflation rate rises, as can be seen from a comparison of columns 3 and 4 with columns 1 and 2. This follows from the quadratic characterization of leverage costs. Column 5 shows the results when a complete insurance capability for capital taxation is allowed. The impacts are smaller, but still substantial.

5.6 Comparison With Changes in Capital Tax Rates

Table 5.7 compares the steady-state impacts of a permanent 1 point decrease in inflation with a permanent 1 point decrease in individual capital tax rates. The corporate income and capital gains tax reductions generate steady-state output and welfare gains which are about half as large as the inflation decrease. The dividend income tax reduction produces about one-fifth the output effect and the interest income tax reduction has about one-tenth the output effect of the inflation reduction.

Table 5.6
Steady-State Impact of a Permanent 1 Point Decrease in Inflation On Key Income, Expenditure, Wealth and Rate of Return Variables Under Alternative Assumptions (Per Cent Shock Minus Control)

Variable	Ctl: $\pi = 4$ Endogenous Leverage	Ctl: $\pi = 4$ Exogenous Leverage	Ctl: $\pi = 8$ Endogenous Leverage	Ctl: $\pi = 8$ Exogenous Leverage	Cap. Tax Insurance
Commercial Output	1.07	0.92	0.93	0.69	0.67
Consumption by Equity-Holders	2.91	2.95	2.14	2.03	2.03
Consumption by Non-Equity-Holders	0.39	0.30	0.43	0.28	0.23
Consumption	0.61	0.53	0.56	0.42	0.38
Capital Stock	2.97	2.55	2.57	1.92	1.85
Wealth of Equity-Holders	3.14	2.76	2.49	1.88	2.05
Wealth of Non-Equity-Holders	0.18	0.15	0.22	0.18	0.21
Wealth	0.40	0.35	0.38	0.29	0.35
Human Wealth	0.64	0.61	0.51	0.48	0.62
Capital Wealth (1)	-0.53	-0.71	-0.13	-0.41	-0.75
Corporate Debt	-4.44	2.75	-1.93	1.88	-7.88
Equity	5.90	2.75	4.54	1.88	5.35
CCA Base	10.14	9.69	8.16	7.48	8.94
Welfare of Equity-Holders	2.62	3.04	1.75	2.14	1.97
Welfare of Non-Equity-Holders	0.61	0.45	0.63	0.39	0.25
User Cost (1)	-0.33	-0.29	-0.31	-0.23	-0.21
Real Cost of Funds (1)	-0.38	-0.34	-0.33	-0.25	-0.25
Real Cost of Funds (2)	-0.06	-0.03	-0.07	-0.02	0.02
Real Cost of Funds (3)	-0.05	0.02	-0.08	0.02	-0.01
Return on Equity (1)	-0.82	-0.52	-0.80	-0.45	-0.70
Return on Equity (2)	-0.20	-0.11	-0.22	-0.12	-0.11
Return on Equity (3)	-0.06	0.00	-0.08	-0.01	0.00
Real Corporate Rate (1) *	-0.57	-0.27	-0.50	-0.23	-0.63
Real Corporate Bond Rate (2)	-0.03	0.16	-0.01	0.17	-0.07
Real Corporate Bond Rate (3)	-0.17	0.05	-0.13	0.07	-0.21
Real Government Rate (1) *	-0.32	-0.33	-0.30	-0.31	-0.34
Real Government Bond Rate (3)	0.02	0.01	0.01	0.01	0.00
Real Cost of Funds Premium (3)	-0.07	0.01	-0.09	0.01	-0.01
Equity Premium (3)	-0.07	-0.01	-0.09	-0.01	0.00
Corporate Bond Premium (3)	-0.18	0.04	-0.14	0.06	-0.21
Leverage	-1.97	0.00	-1.44	0.00	-2.42
Total Saving Rate	0.36	0.31	0.30	0.22	0.23

(1) Pre-corporate tax (2) After-corporate tax (3) After-personal tax * Fisher real rates

Table 5.7
Steady-State Impacts of a Permanent 1 Point Decreases in Inflation and Individual Capital Tax Rates On Key Income, Expenditure, Wealth and Rate of Return Variables Under Alternative Assumptions (Per Cent Shock Minus Control)

Variable	Inflation Reduction	Corporate Income Tax Reduction	Interest Income Tax Reduction	Capital Gains Tax Reduction	Dividend Inc. Tax Reduction
Commercial Output	1.07	0.54	0.10	0.43	0.22
Consumption by Equity-Holders	2.91	1.61	0.32	0.60	0.63
Consumption by Non-Equity-Holders	0.39	0.19	0.03	0.22	0.08
Consumption	0.61	0.31	0.06	0.25	0.13
Capital Stock	2.97	1.49	0.26	1.20	0.61
Wealth of Equity-Holders	3.14	1.69	0.26	0.53	0.61
Wealth of Non-Equity-Holders	0.18	0.09	0.02	0.13	0.04
Wealth	0.40	0.21	0.04	0.16	0.09
Human Wealth	0.64	0.33	0.07	0.26	0.14
Capital Wealth (1)	-0.53	-0.29	-0.09	-0.22	-0.15
Corporate Debt	-4.44	-1.01	-0.42	0.56	0.63
Equity	5.90	2.67	0.20	0.52	0.61
CCA Base	10.14	1.49	0.26	1.20	0.61
Welfare of Equity-Holders	2.62	1.50	0.37	0.66	0.65
Welfare of Non-Equity-Holders	0.61	0.29	0.05	0.31	0.12
User Cost (1)	-0.33	-0.17	0.03	-0.14	-0.07
Real Cost of Funds (1)	-0.38	-0.21	-0.03	-0.07	-0.08
Real Cost of Funds (2)	-0.06	0.02	-0.02	-0.05	-0.05
Real Cost of Funds (3)	-0.05	-0.02	-0.01	0.00	0.00
Return on Equity (1)	-0.82	-0.41	-0.01	-0.09	-0.10
Return on Equity (2)	-0.20	-0.04	0.00	-0.06	-0.06
Return on Equity (3)	-0.06	-0.02	0.00	0.01	0.00
Real Corporate Rate (1) *	-0.57	0.05	-0.07	-0.01	-0.01
Real Corporate Bond Rate (2)	-0.03	-0.10	-0.11	-0.01	-0.01
Real Corporate Bond Rate (3)	-0.17	-0.08	-0.03	-0.01	-0.01
Real Government Rate (1) *	-0.32	-0.01	-0.14	0.01	0.00
Real Government Bond Rate (3)	0.02	0.00	0.00	0.00	0.00
Real Cost of Funds Premium (3)	-0.07	-0.03	0.01	0.00	0.00
Equity Premium (3)	-0.07	-0.03	0.00	0.00	0.00
Corporate Bond Premium (3)	-0.18	-0.08	0.03	0.00	0.00
Leverage	-1.97	-0.71	0.04	0.01	0.00
Total Savings Rate	0.36	0.18	0.03	0.15	0.08

(1) Pre-corporate tax (2) After-corporate tax (3) After-personal tax * Fisher real rates

6 Conclusions

This paper has constructed a dynamic computable general equilibrium model incorporating endogenous leverage and heterogeneous equity and non-equity holding households, with the decisions of firms and households based upon expected future paths of capital and labour income, real after-tax interest rates and equity returns. The simulation results suggest that a permanent anticipated reduction in inflation can, through interactions with a capital tax system similar to that of Canada, generate significant increases in the capital stock, output and welfare. A permanent 1 point reduction in the rate of inflation raises steady-state values of commercial sector output by 1.07 per cent, of the capital stock by 2.97 per cent, of equity-holding household welfare by 2.62 per cent, and of non-equity holding household welfare by 0.61 per cent. Half of the output adjustment to the new steady state occurs approximately every 14 years. Lower inflation generates these benefits by reducing the distorting tax wedges which exist between the returns on capital paid by firms and the returns received by households, reducing the user cost of capital and raising investment and the capital stock. The wedges are inflation-sensitive because firms may deduct interest payments at a corporate tax rate exceeding the personal tax rate on interest income, while the base for both corporate interest deductions and personal tax is nominal interest paid. Lower inflation also significantly reduces the corporate equity wedge through a lower nominal inventory valuation component and a higher steady-state real capital consumption allowance base.

It should be stressed that these results capture only the interaction of inflation with the capital tax system, and ignore a number of other channels through which inflation may have real effects, such as velocity, menu and uncertainty costs.

Higher expected inflation raises the nominal interest rate, thereby increasing the opportunity cost of holding non-interest bearing money. This reduces the incentive to hold such money and increases its velocity. This channel has been examined by, among others, Bailey (1956), Friedman (1969), Barro (1972), Frenkel (1976), Feldstein (1979) and Fischer (1981). Its magnitude is not likely to be large, however, given the small size of the non-interest bearing money stock relative to an aggregate like M2.

Much of the inflation cost literature has concerned the role of inflation uncertainty and variability. This literature is summarized in Driffill, Mizon and Ulph (1989). Cukierman (1984) uses the Lucas (1973) model with many markets and imperfect information to show how inflation can increase the confusion between aggregate and relative price changes, leading to inappropriate responses of output to real and monetary shocks. Agents are assumed not to know the current aggregate price level with certainty until the next period. They know the current price level in their local market, and based upon a distribution of the local prices across markets around the aggregate price level make inferences concerning the current aggregate price level. This can cause output in individual markets to depend upon aggregate monetary shocks.

If firms face a fixed menu cost of changing prices, then price adjustments will be spaced discretely in time, rather than occurring continuously. Sheshinski and Weiss (1977), (1983) showed that it will be optimal for a firm to increase prices every time its real price

falls below some minimum value. If price changes across firms do not occur simultaneously, then higher inflation will lead to a greater cross-sectional variation of real prices. This represents a distortion and diminution of the information content of the price system, since relative prices no longer simply reflect underlying tastes and technology.

These additional channels create a relationship between total factor productivity and inflation, and would reinforce the gains from lower inflation captured in this model. Ball and Cecchitti (1990) argue that inflation can create uncertainty about the future conduct of monetary policy, owing to a lack of policy consensus at postive inflation creating the possibility of "stop-go" policies. This could create a positive relationship between real capital return variances and the level of inflation.

The results are quite robust over a range of assumptions. The estimated capital tax interaction benefits of reduced inflation are greater when leverage is modelled as endogenous, and the impact upon the estimated gain increases as the level of the control scenario inflation rate rises. Reduced inflation affects leverage by lowering the marginal tax advantage of debt which exists because firms may deduct interest payments at a corporate tax rate exceeding the personal tax rate on interest income. Since the base for both corporate interest deductions and personal tax is nominal interest paid, the lowering of the inflation component of the tax and deduction base reduces the net tax advantage derived from debt financing. The decrease in the marginal tax advantage of debt causes leverage to fall, which decreases deadweight bankruptcy and other leverage costs and leads to a lowering of corporate debt default risk premia. Smaller, but still substantial impacts are obtained when an insurance against capital return risk role is allowed for capital taxation.

The capital tax interaction gains from reduced inflation are substantial even when the permanent inflation reduction is anticipated to be delayed until some future point. Anticipated temporary inflation reductions, however, yield significantly smaller benefits. Indeed, the results suggest that while short and long anticipated inflation reductions can lead to a Pareto improvement, there can also exist an intermediate length of anticipated reduction which makes the equity-holding household better off, but the non-equity-holding household worse off. Social welfare may, nevertheless, be higher for temporary reductions of any length over a wide range of agent weightings. The results confirm the importance attached by Goulder and Summers (1990) to the importance of the dynamic consequences of timing issues in the analysis of policy innovations.

The model's heterogeneous agent and endogenous leverage features could be usefully combined with a multi-sector open economy framework such as that developed by Goulder and Eichengreen (1992). The open economy extension in particular would clearly provide greater analytic applicability for small open economies such as Canada. Modelling inflation as a stochastic process would allow relationships between inflation levels and uncertainty to be captured. Introducing a real capital return variance-inflation level relationship motivated by a Ball and Cecchitti-type policy uncertainty framework could be usefully explored and might, in the context of the heterogeneous household approach, help explain the coexistence of negative *ex ante* real safe rates (see Bonser-Neale (1990)) with high earnings-price ratios during the high-inflation 1970s.

CHART 5.1
IMPACT OF A 1 POINT INFLATION REDUCTION
ON CONSUMPTION, INVESTMENT AND OUTPUT

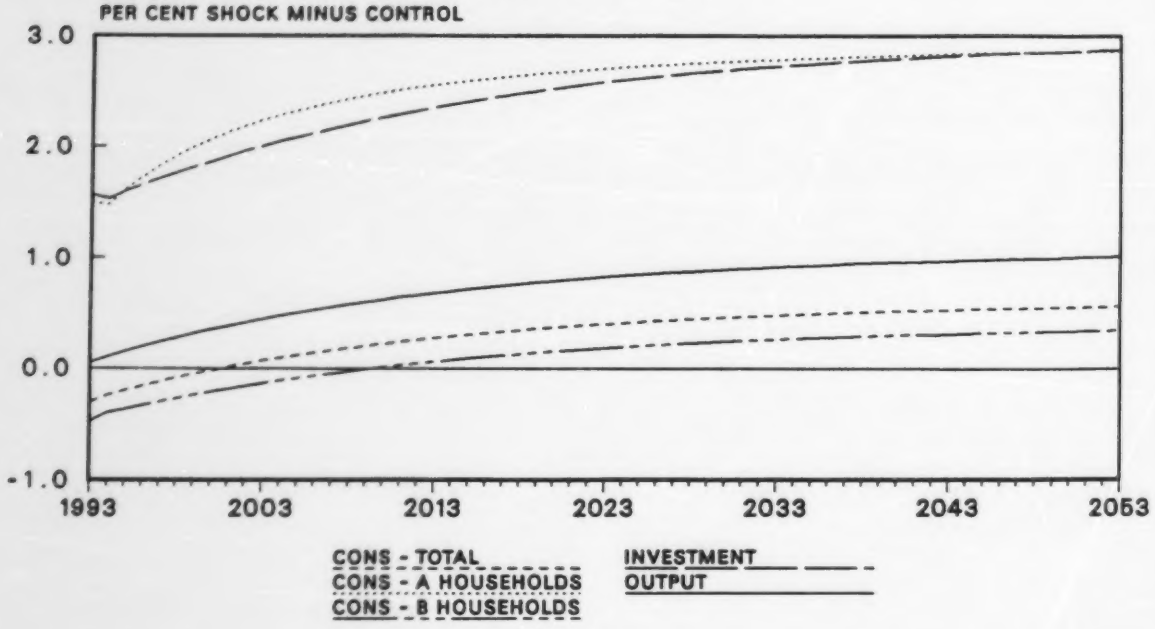


CHART 5.2
IMPACT OF A 1 POINT INFLATION REDUCTION
ON CAPITAL STOCK AND WEALTH

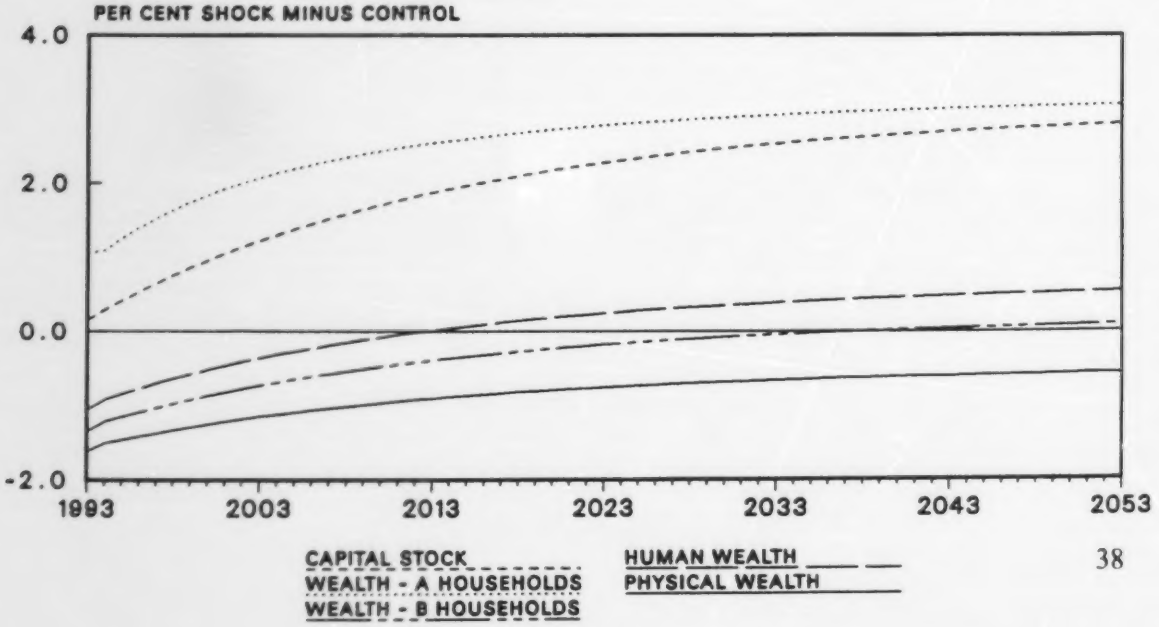


CHART 5.3
IMPACT OF A 1 POINT INFLATION REDUCTION
ON VALUE OF CCA ON NEW AND EXISTING CAPITAL

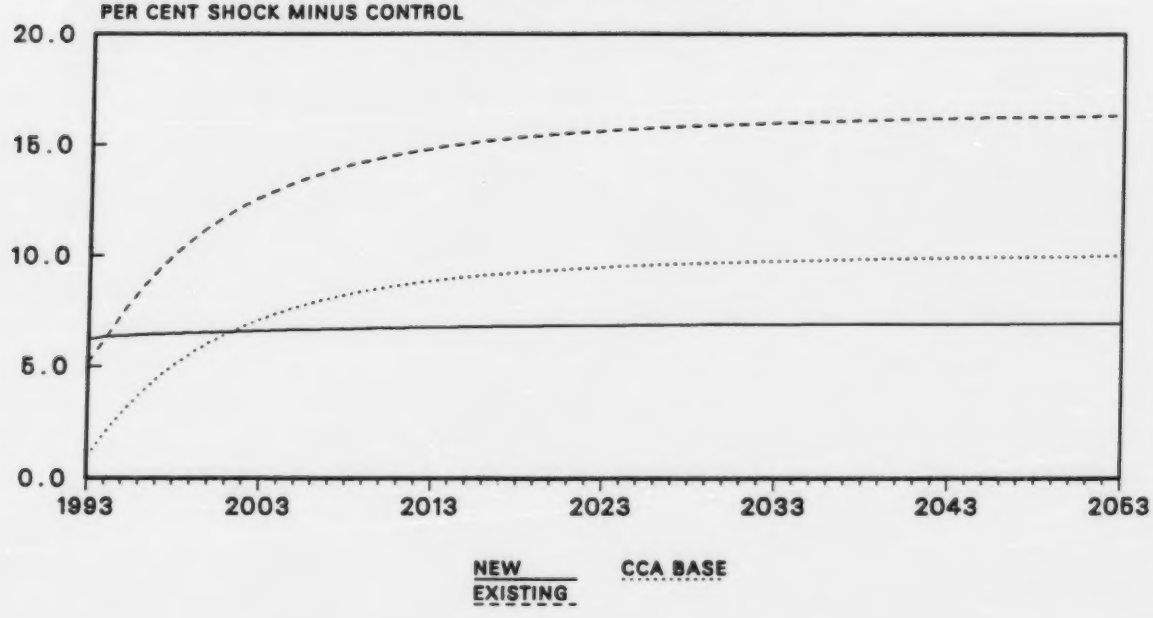


CHART 5.4
IMPACT OF A 1 POINT INFLATION REDUCTION
ON HOUSEHOLD WELFARE

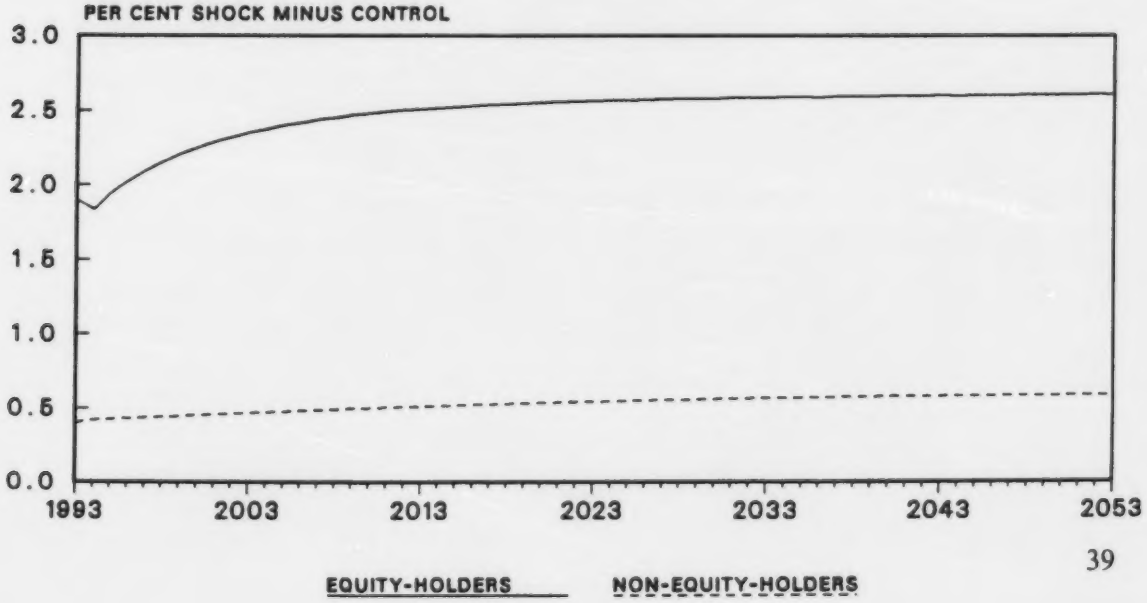


CHART 5.5
IMPACT OF A 1 POINT INFLATION REDUCTION
ON CAPITAL RETURNS AND MARGINAL PRODUCT

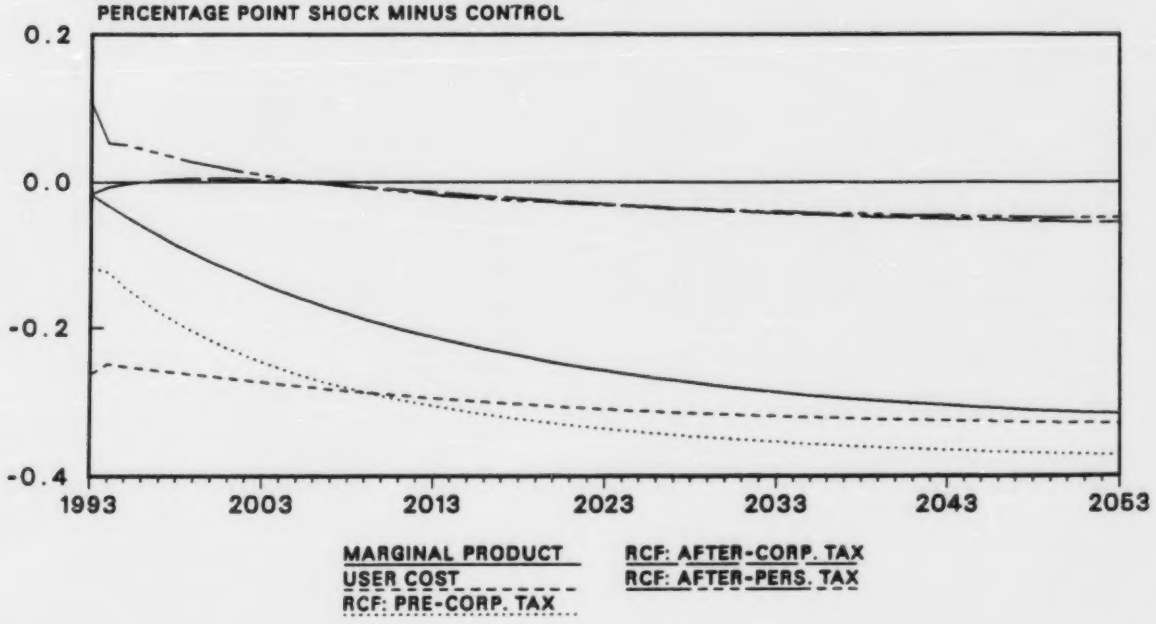


CHART 5.6
IMPACT OF A 4, 8, 16, 24, AND 32 YEAR AND PERMANENT
1 POINT INFLATION REDUCTION ON OUTPUT

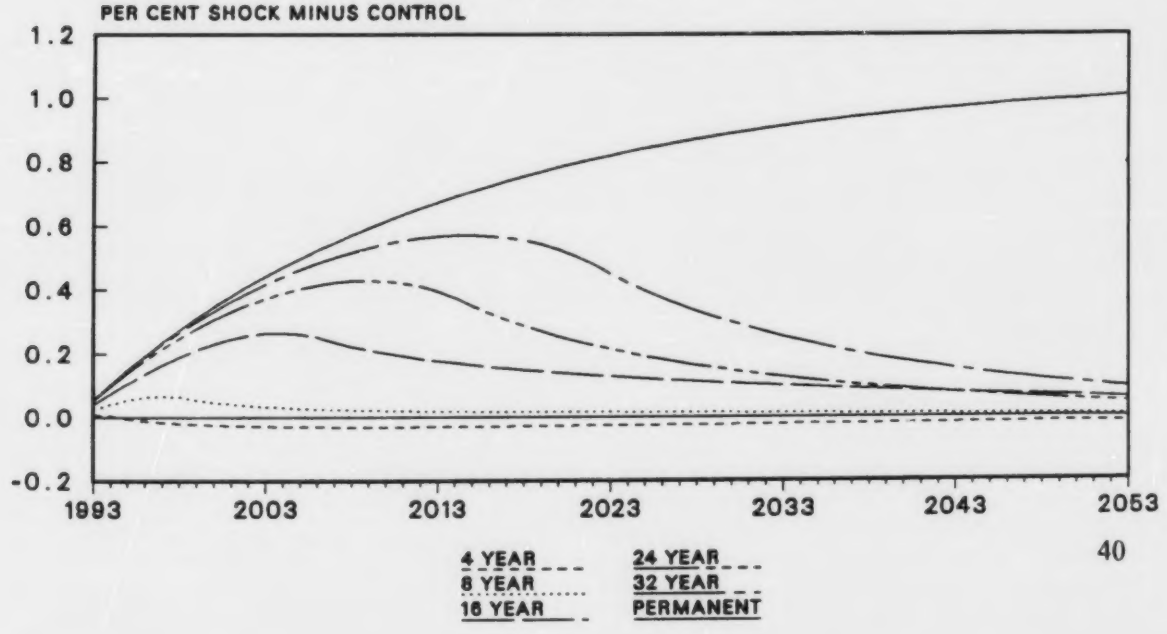


CHART 5.7
IMPACT OF A 4, 8, 16, 24, AND 32 YEAR AND PERMANENT
1 POINT INFLATION REDUCTION ON EQUITY-HOLDER CONSUMPTION

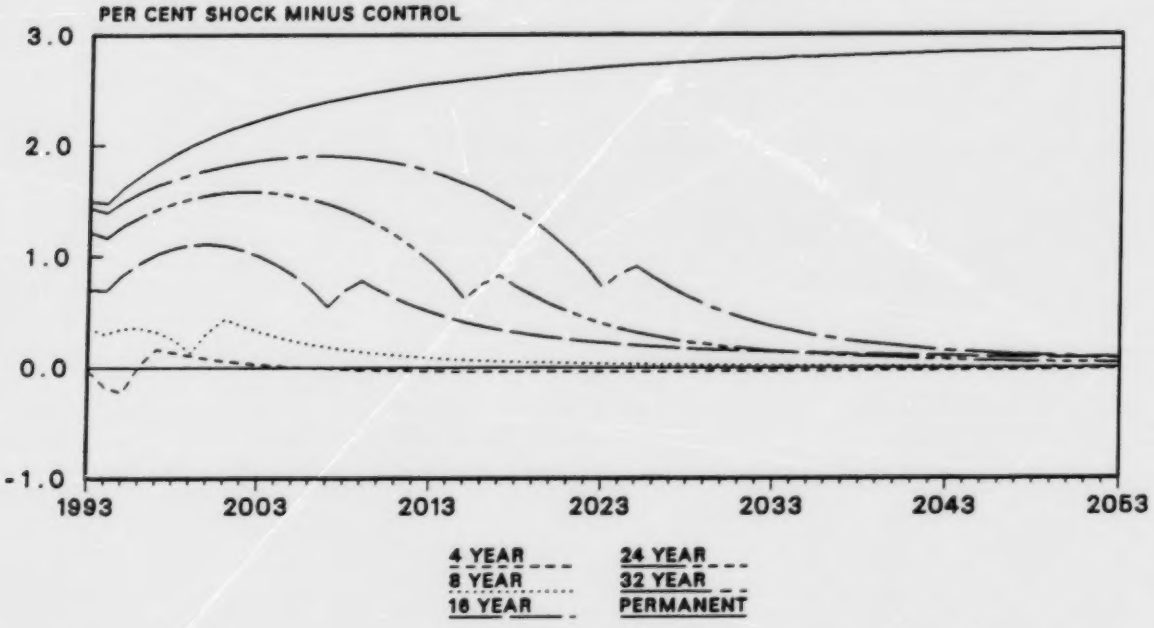


CHART 5.8
IMPACT OF A 4, 8, 16, 24, AND 32 YEAR AND PERMANENT
1 POINT INFLATION REDUCTION ON NON-EQUITY-HOLDER CONSUMPTION

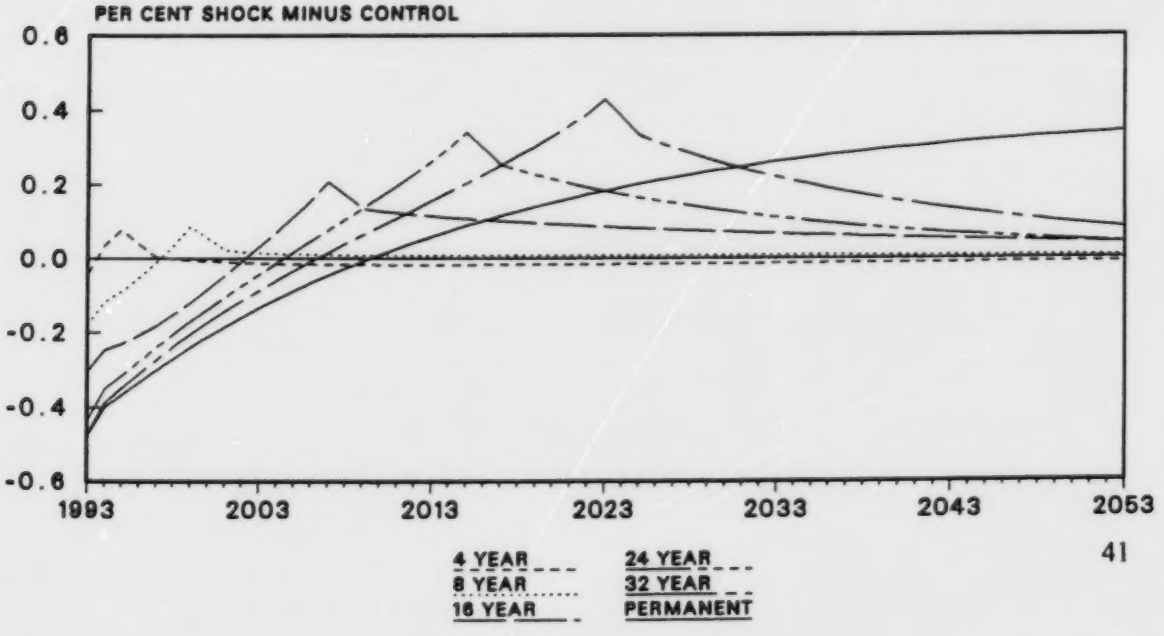


CHART 5.9
IMPACT OF A 4, 8, 16, 24, AND 32 YEAR AND PERMANENT
1 POINT INFLATION REDUCTION ON CONSUMPTION

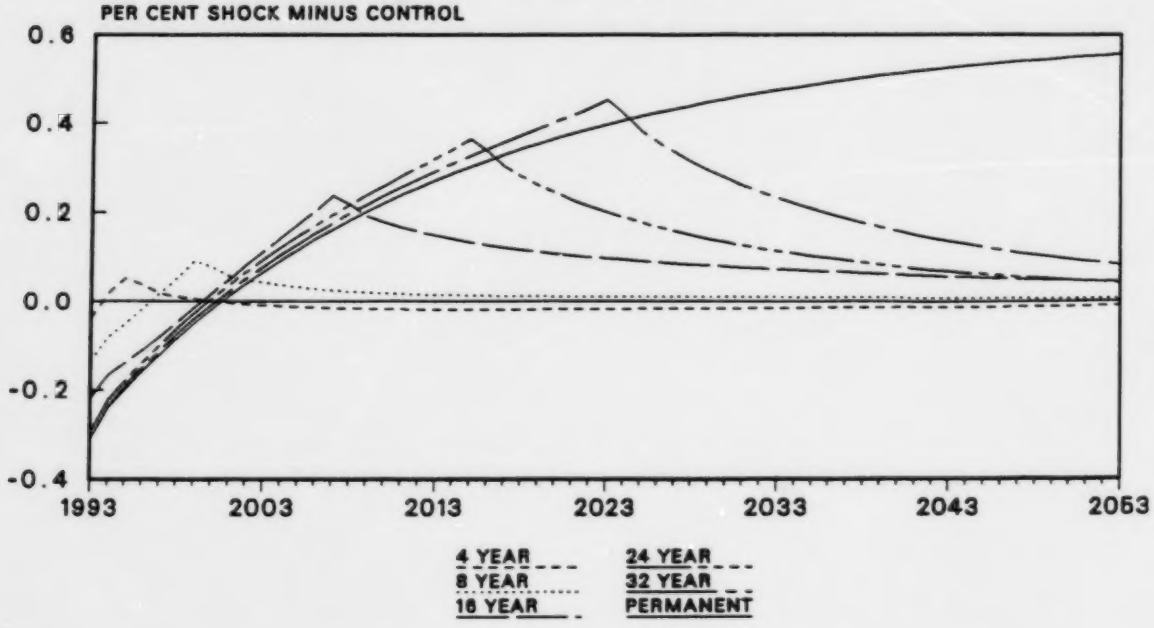


CHART 5.10
IMPACT OF A 4, 8, 16, 24, AND 32 YEAR AND PERMANENT
1 POINT INFLATION REDUCTION ON INVESTMENT

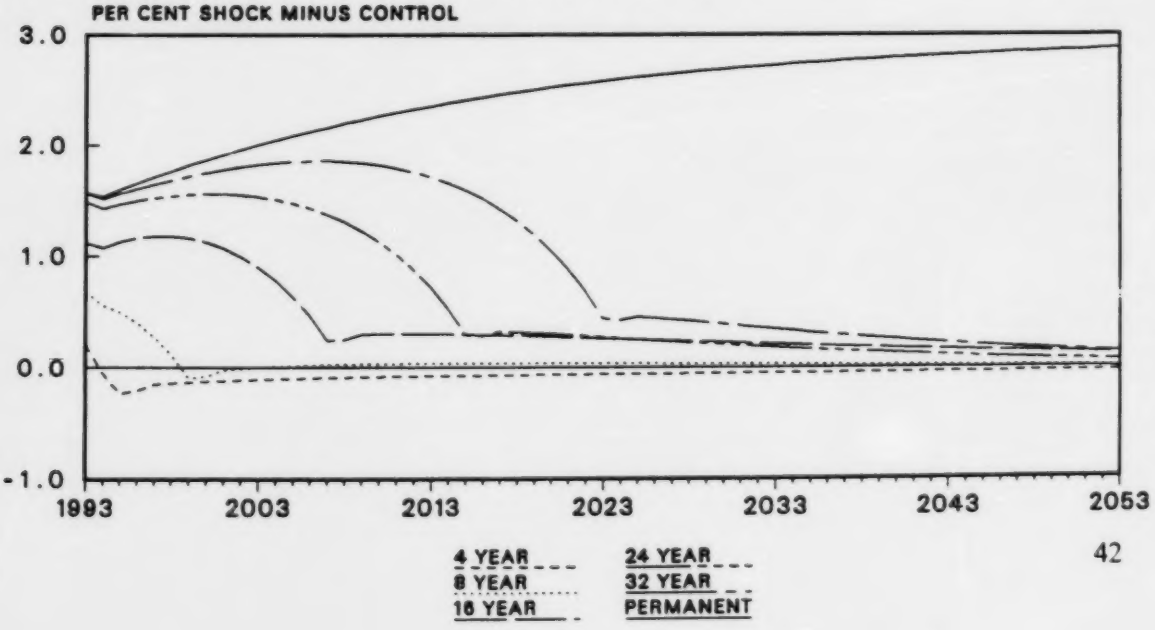


CHART 5.11
IMPACT OF A 4, 8, 16, 24, AND 32 YEAR AND PERMANENT
1 POINT INFLATION REDUCTION ON EQUITY-HOLDER WEALTH

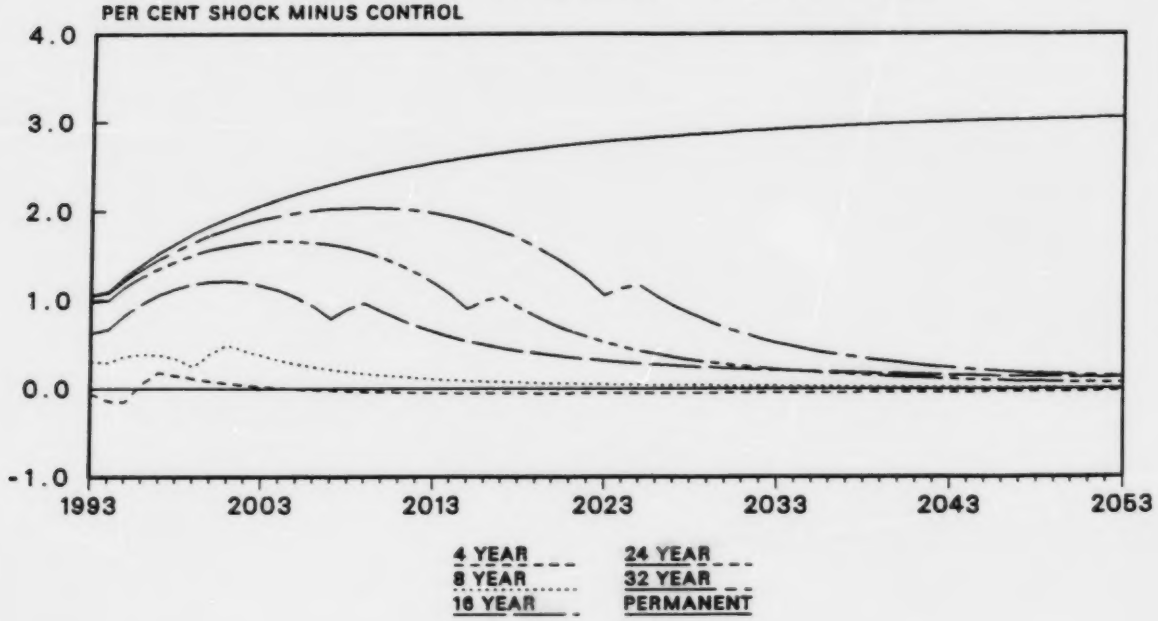


CHART 5.12
IMPACT OF A 4, 8, 16, 24, AND 32 YEAR AND PERMANENT
1 POINT INFLATION REDUCTION ON NON-EQUITY-HOLDER WEALTH

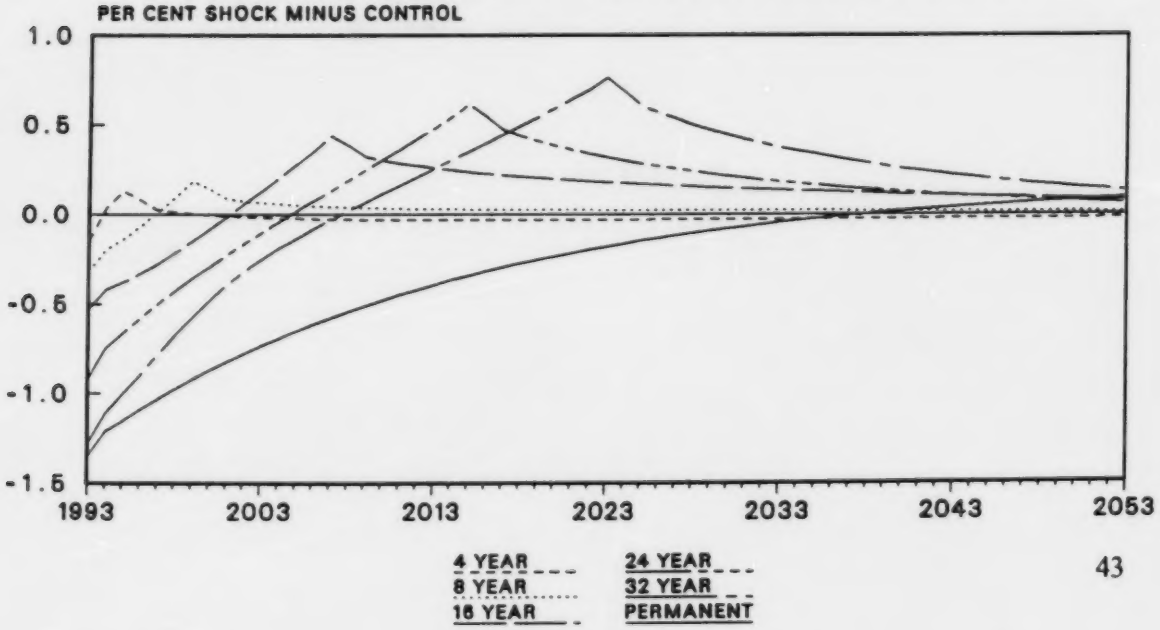


CHART 5.13
IMPACT OF A 4, 8, 16, 24, AND 32 YEAR AND PERMANENT
1 POINT INFLATION REDUCTION ON WEALTH

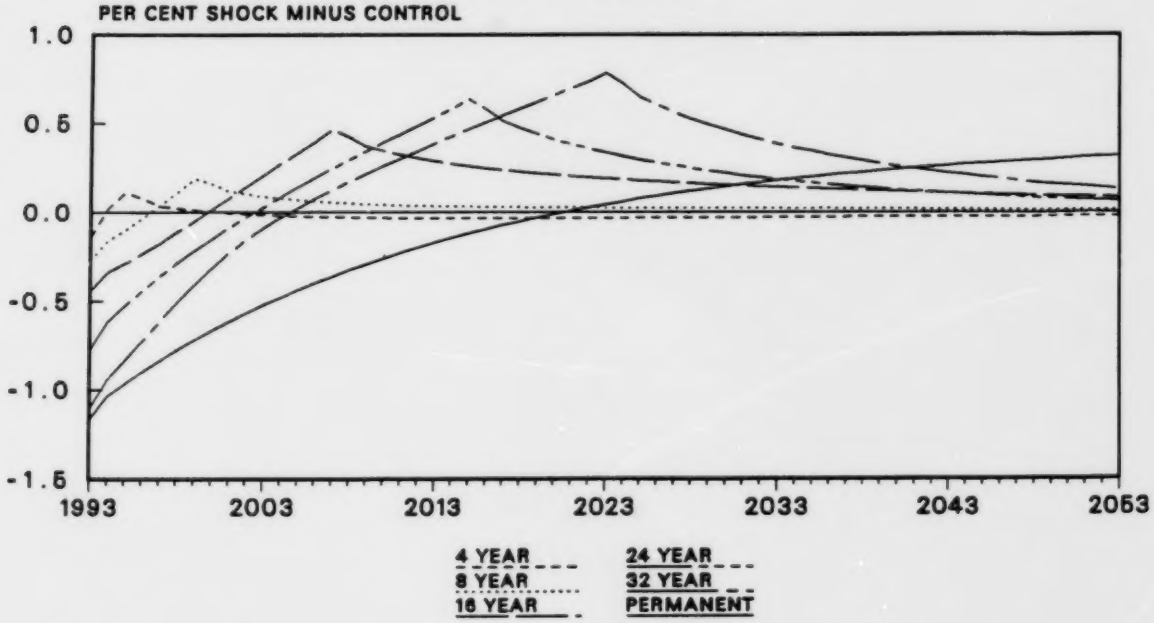


CHART 5.14
IMPACT OF A 4, 8, 16, 24, AND 32 YEAR AND PERMANENT
1 POINT INFLATION REDUCTION ON CORPORATE DEBT

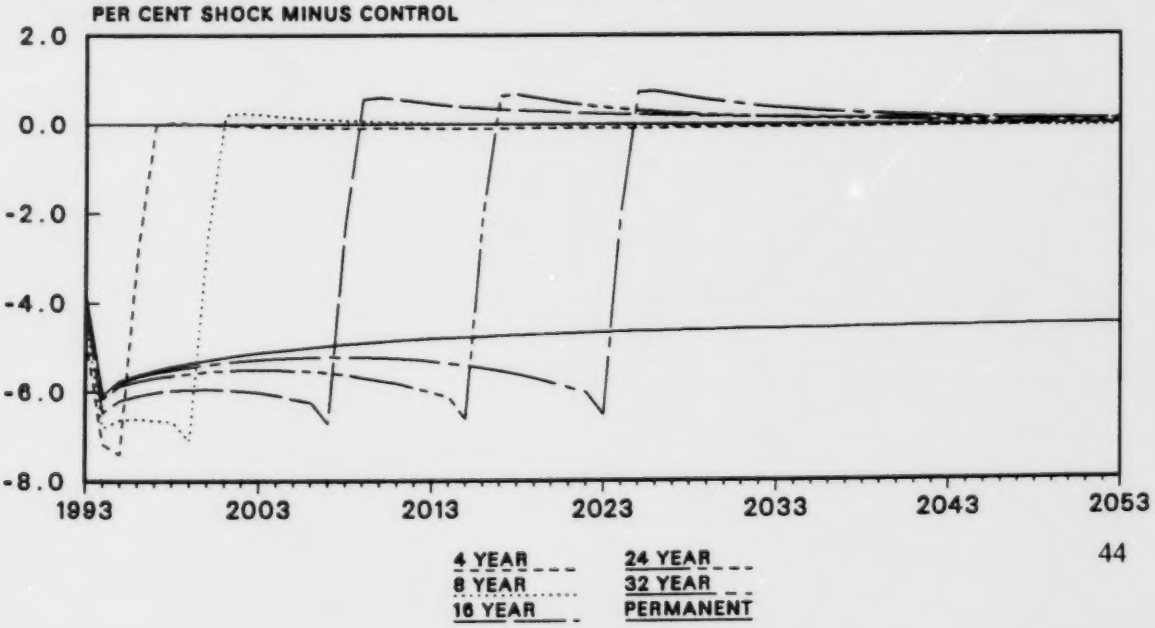


CHART 5.15
IMPACT OF A 4, 8, 16, 24, AND 32 YEAR AND PERMANENT
1 POINT INFLATION REDUCTION ON EQUITY

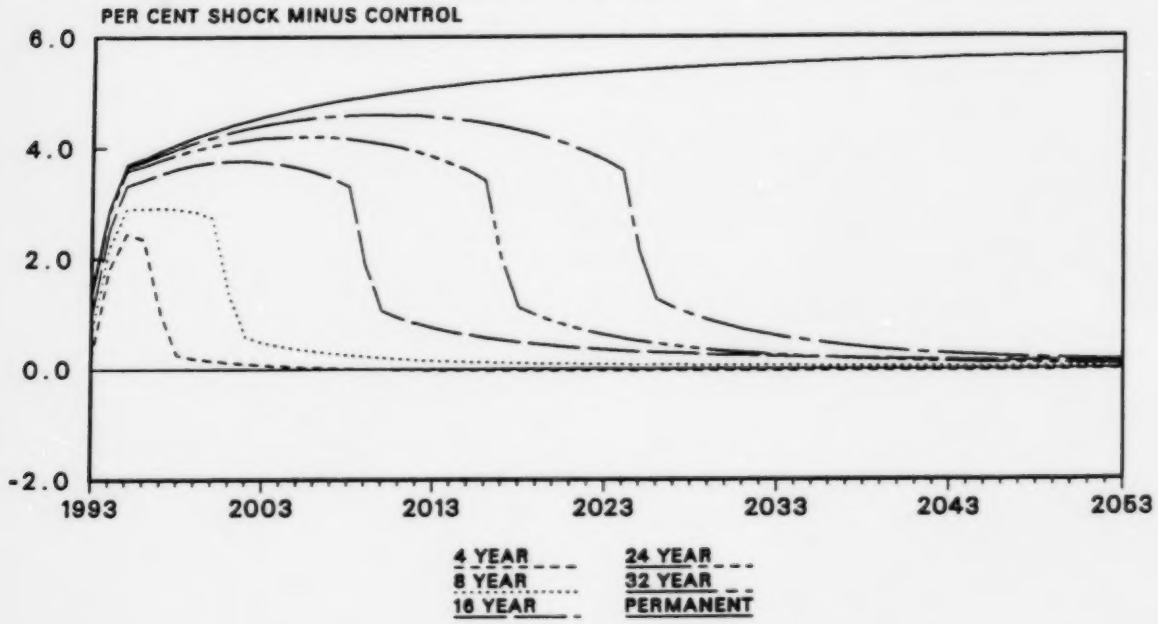


CHART 5.16
IMPACT OF A 4, 8, 16, 24, AND 32 YEAR AND PERMANENT
1 POINT INFLATION REDUCTION ON FIRM VALUE

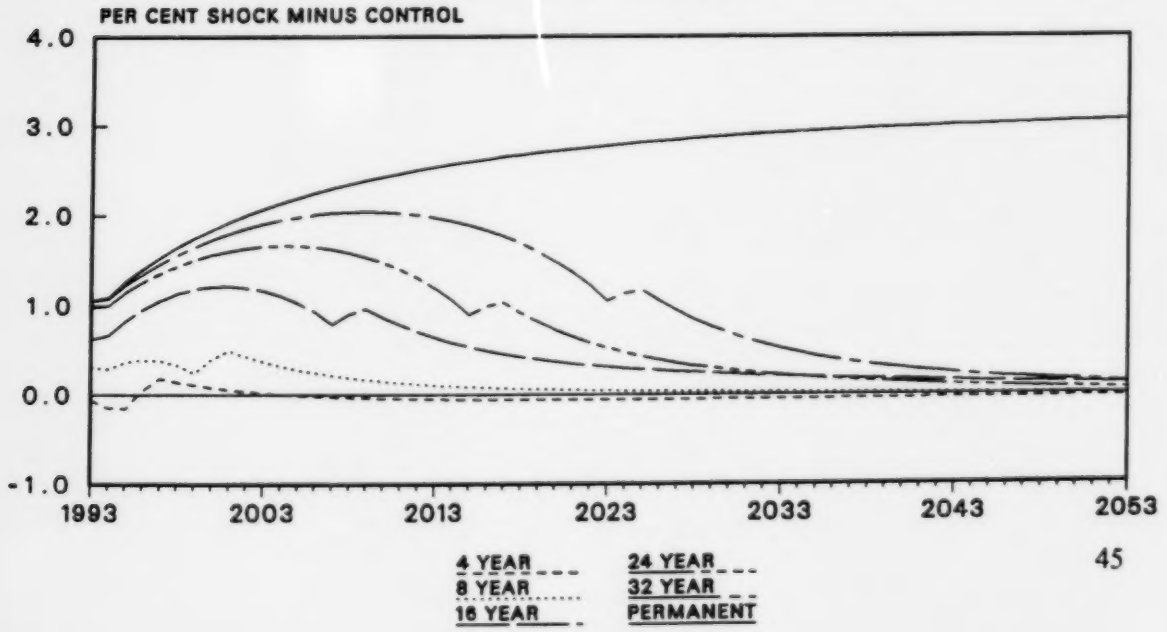


CHART 5.17
IMPACT OF A 4, 8, 16, 24, AND 32 YEAR AND PERMANENT
1 POINT INFLATION REDUCTION ON EQUITY-HOLDER WELFARE

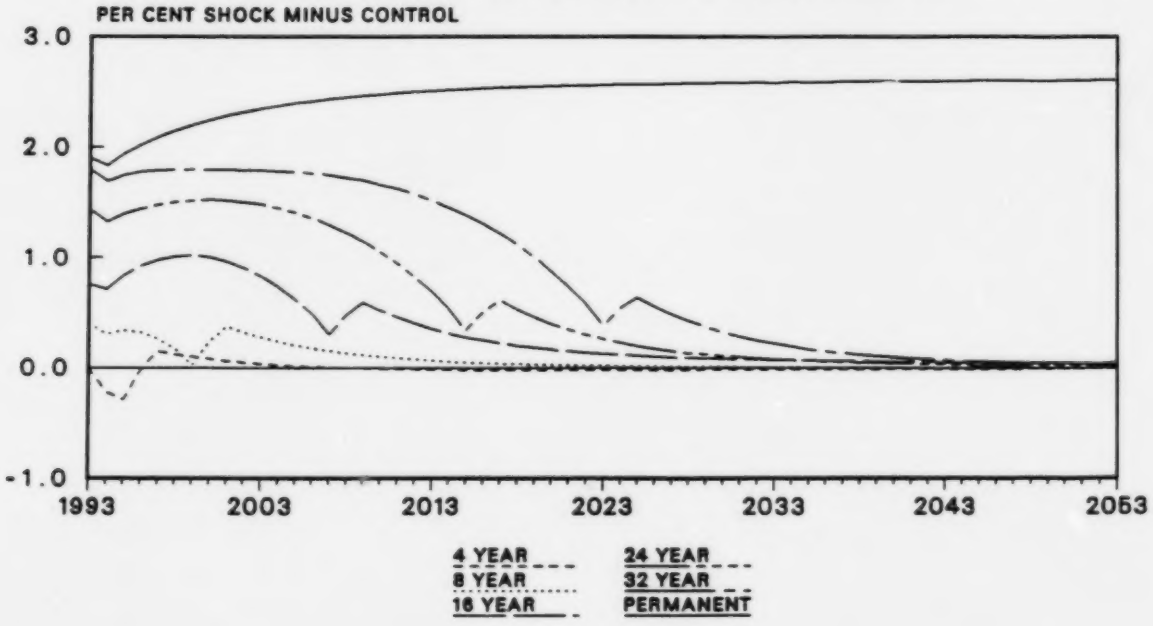


CHART 5.18
IMPACT OF A 4, 8, 16, 24, AND 32 YEAR AND PERMANENT
1 POINT INFLATION REDUCTION ON NON-EQUITY-HOLDER WELFARE

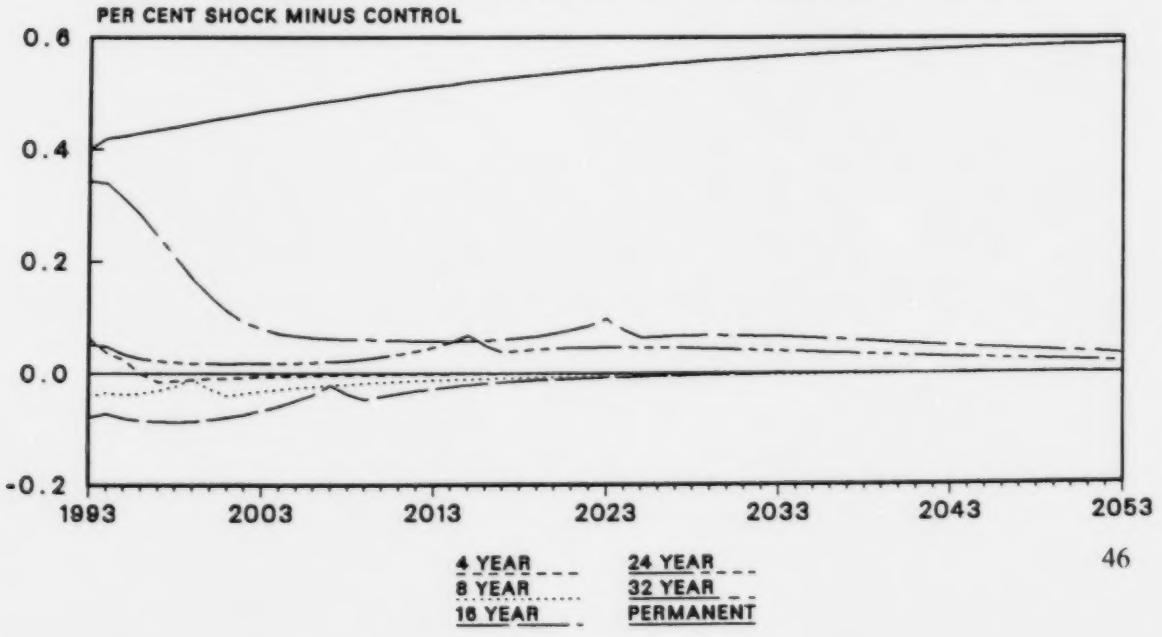


CHART 5.19
IMPACT OF A 4, 8, 16, 24, AND 32 YEAR AND PERMANENT
1 POINT INFLATION REDUCTION ON THE USER COST OF CAPITAL

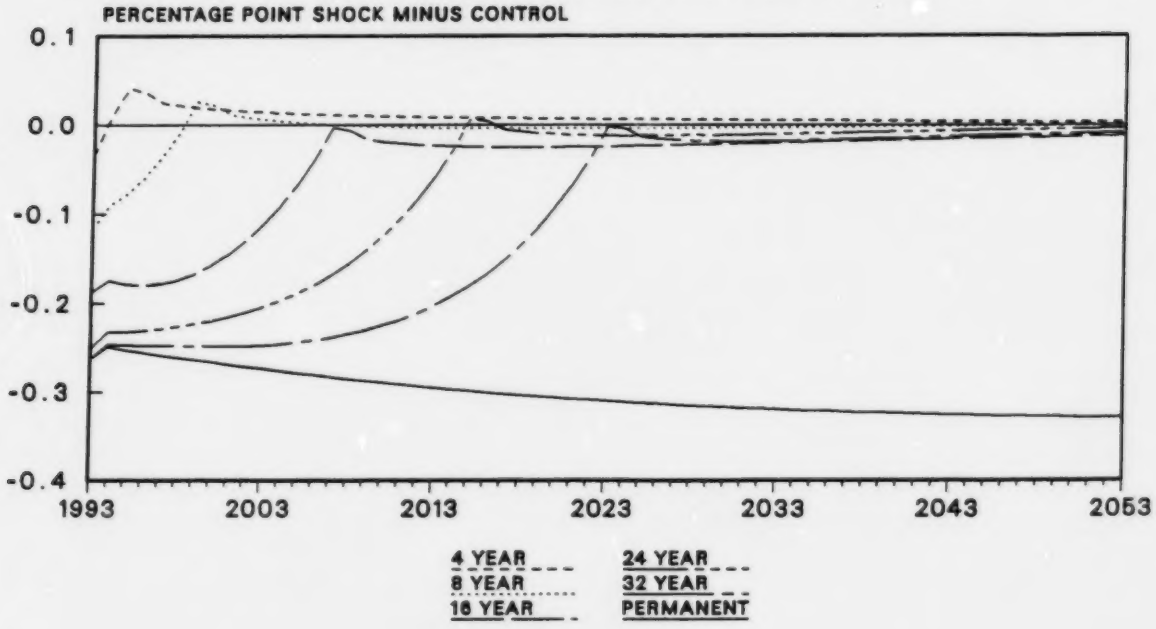


CHART 5.20
IMPACT OF A DELAYED PERMANENT
1 POINT INFLATION REDUCTION ON OUTPUT

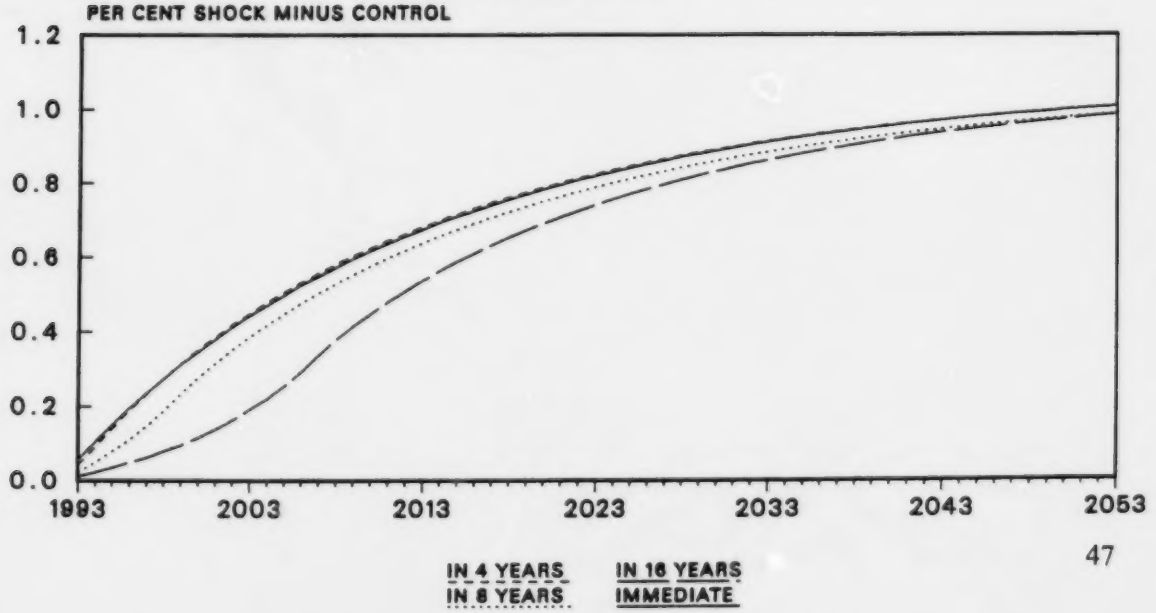


CHART 5.21
IMPACT OF A DELAYED PERMANENT
1 POINT INFLATION REDUCTION ON CONSUMPTION

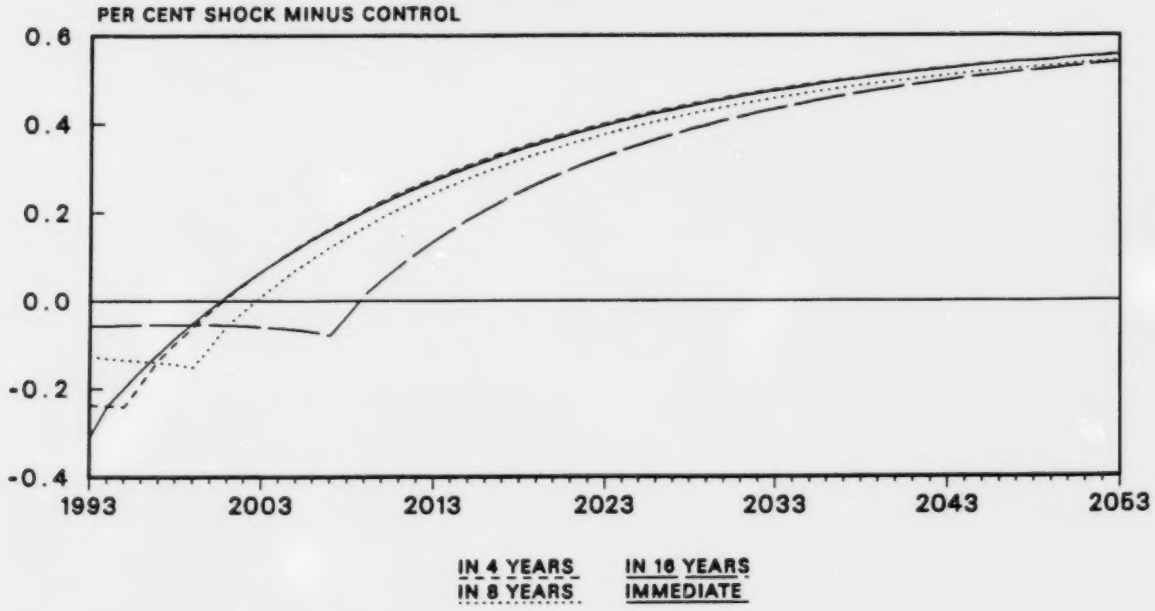


CHART 5.22
IMPACT OF A DELAYED PERMANENT
1 POINT INFLATION REDUCTION ON INVESTMENT

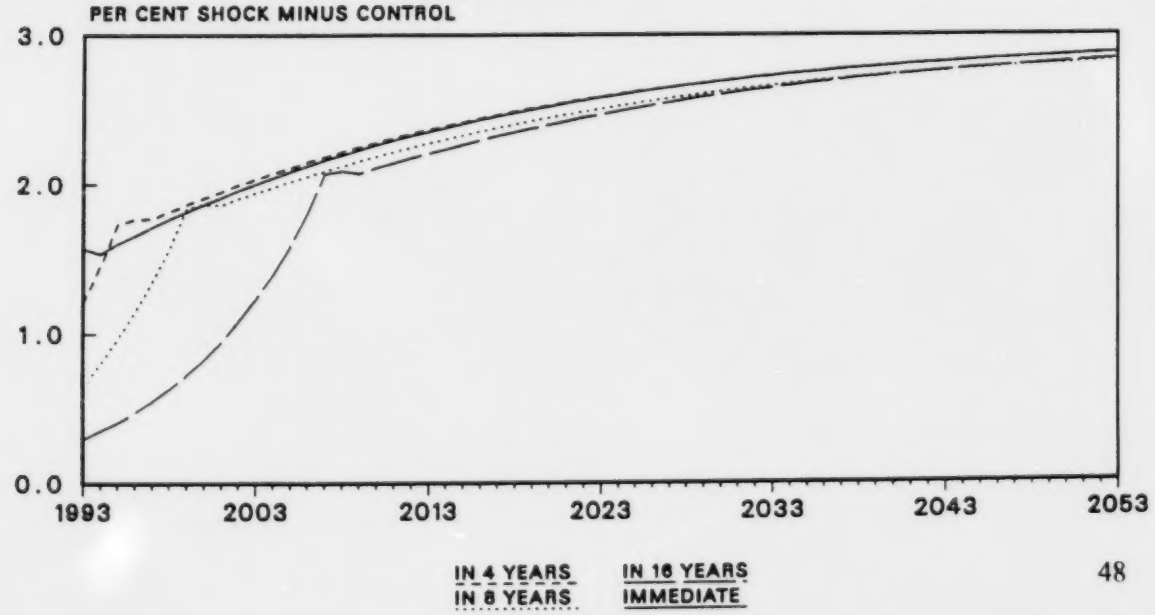


CHART 5.23
IMPACT OF A DELAYED PERMANENT
1 POINT INFLATION REDUCTION ON WEALTH

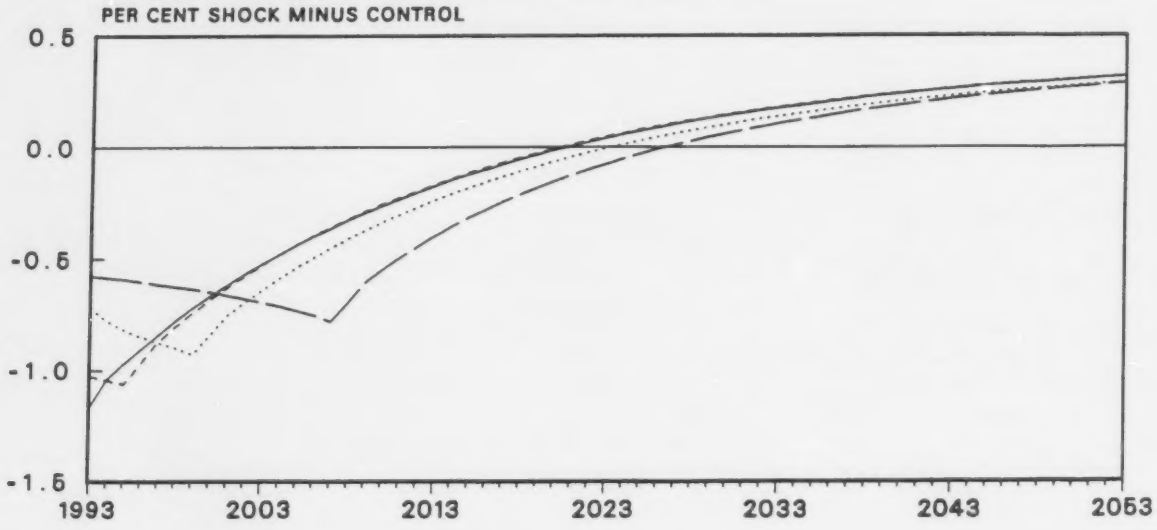


CHART 5.24
IMPACT OF A DELAYED PERMANENT
1 POINT INFLATION REDUCTION ON CORPORATE DEBT

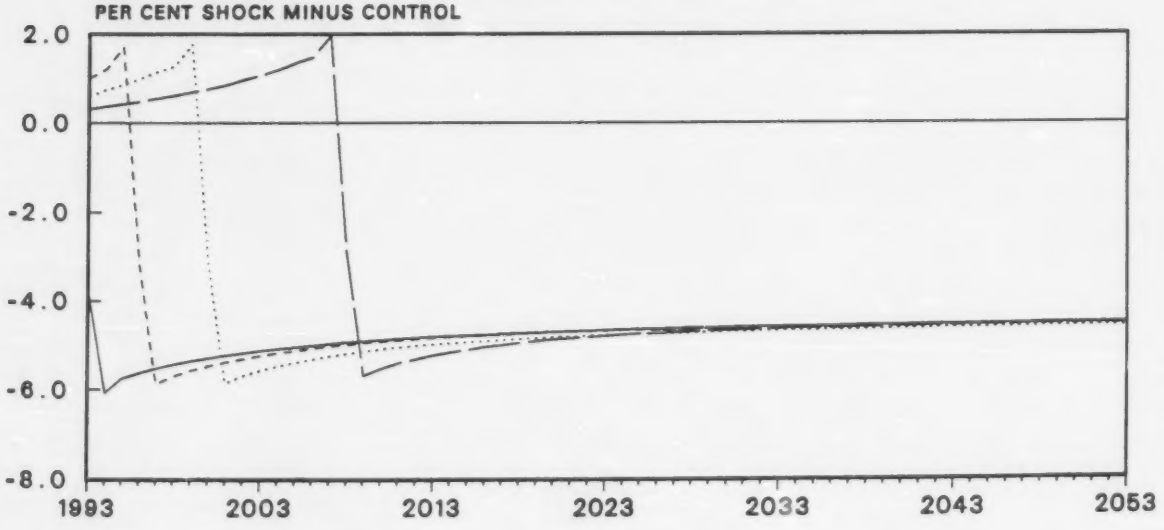


CHART 5.25
IMPACT OF A DELAYED PERMANENT
1 POINT INFLATION REDUCTION ON EQUITY

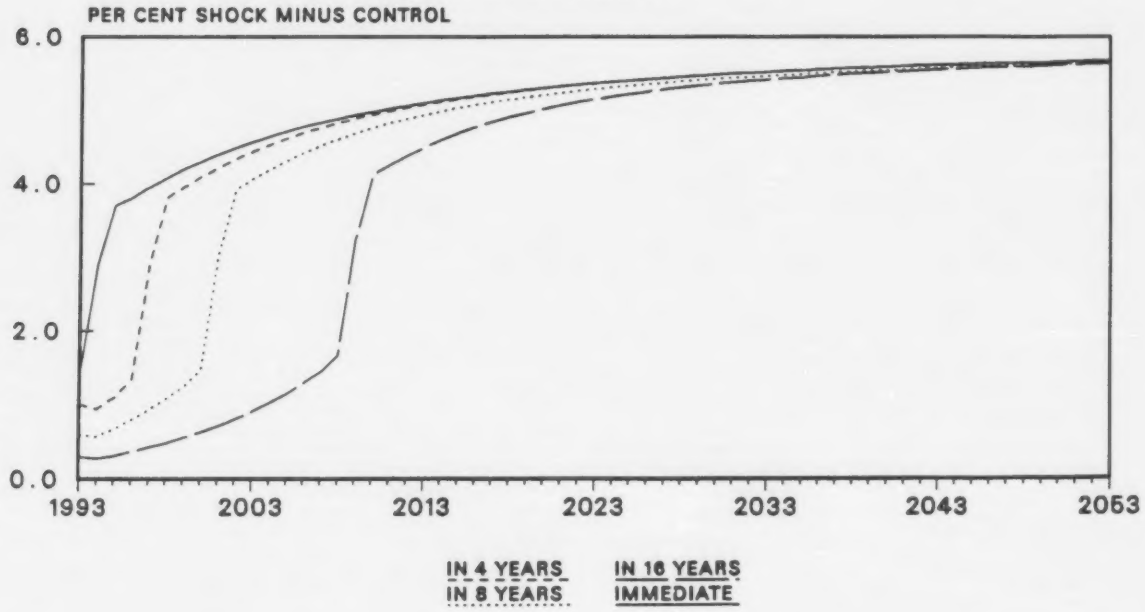


CHART 5.26
IMPACT OF A DELAYED PERMANENT
1 POINT INFLATION REDUCTION ON FIRM VALUE

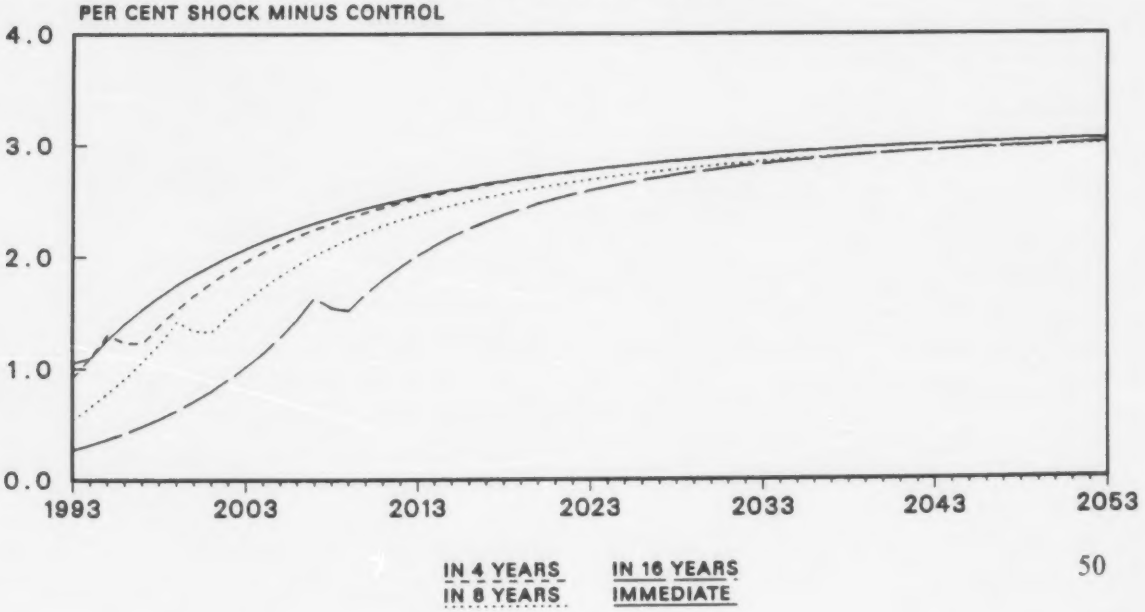


CHART 5.27
IMPACT OF A DELAYED PERMANENT
1 POINT INFLATION REDUCTION ON WELFARE OF EQUITY-HOLDERS

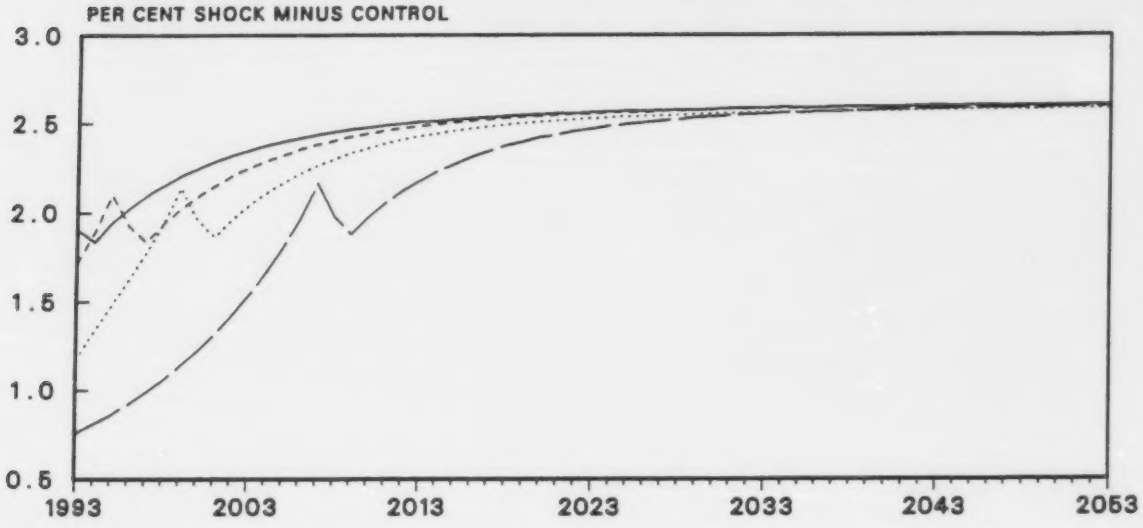


CHART 5.28
IMPACT OF A DELAYED PERMANENT
1 POINT INFLATION REDUCTION ON WELFARE OF NON-EQUITY-HOLDERS

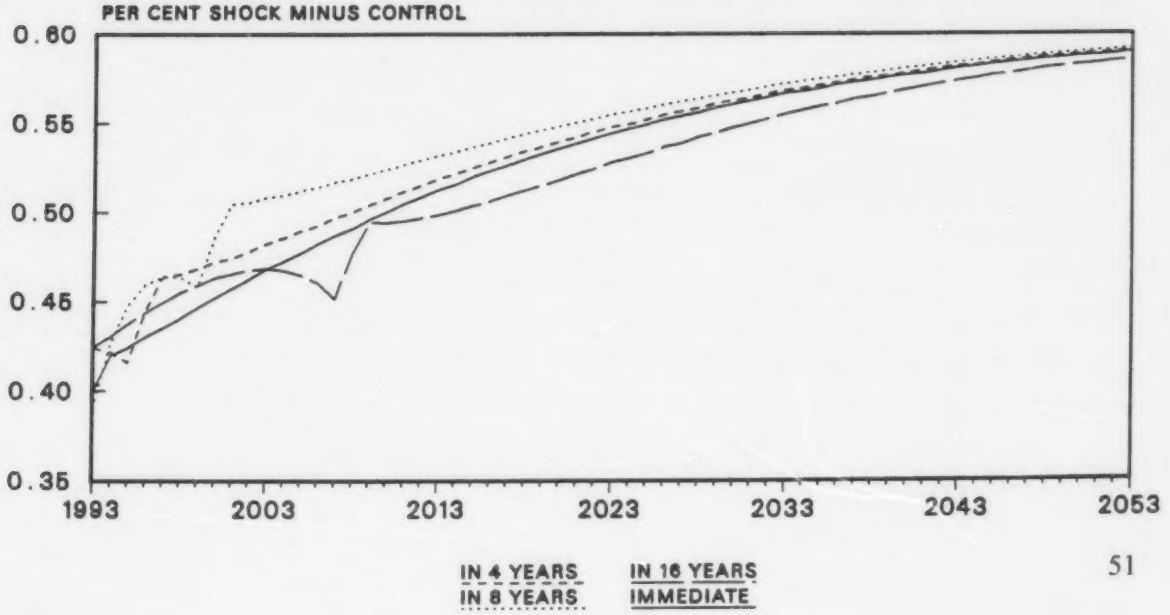
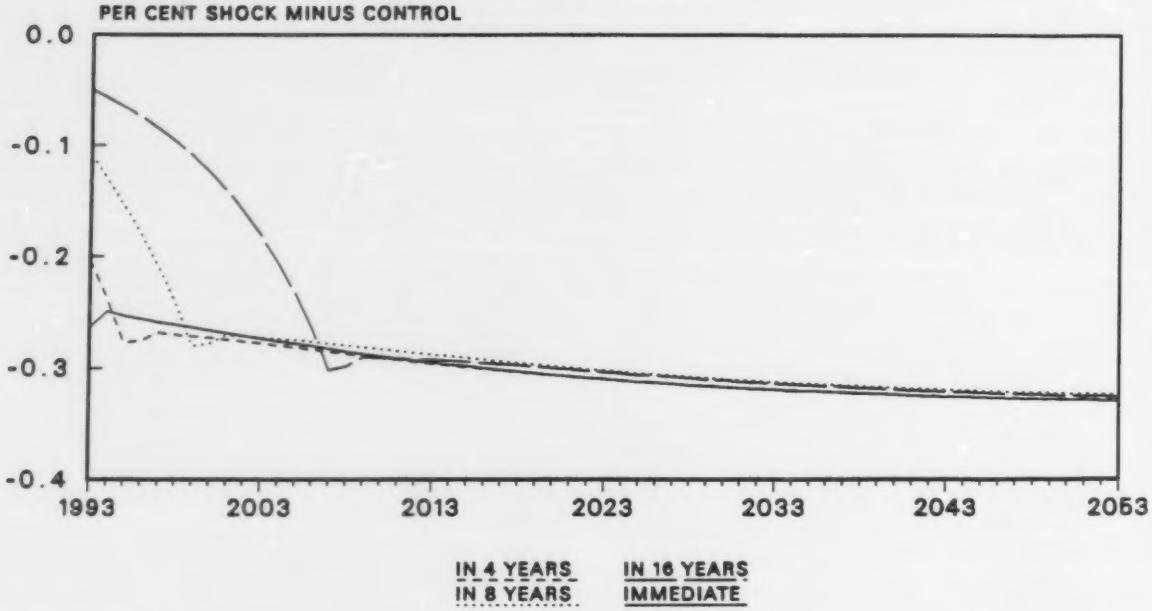


CHART 5.29
IMPACT OF A DELAYED PERMANENT
1 POINT INFLATION REDUCTION ON THE USER COST OF CAPITAL



Appendix - Detailed Tables

Inflation at 4 Per Cent in Control Simulation
Inflation at 3 Per Cent in Shock Simulation

Table A.1 Income, Expenditure and Wealth Accounts (Per Cent Shock Minus Control)
Table A.2 Rates of Return and Asset Positions (Shock Minus Control)
Table A.3 Rates of Return (Control Levels)
Table A.4 Rates of Return (Shock Levels)
Table A.5 Tax Wedges and Effective Tax Rates (Shock Minus Control)
Table A.6 Tax Wedges and Effective Tax Rates (Control Levels)
Table A.7 Tax Wedges and Effective Tax Rates (Shock Levels)

Table A.1: Dynamic General Equilibrium Model Simulation Results
Income, Expenditure and Wealth Accounts
(Per Cent Shock Minus Control)
Control Dset is CTL
Shock Dset is SHKPE2

Year	1	2	3	4	5	6	7	8	9	10	15	20	30	50	145
Output	0.06	0.10	0.15	0.19	0.24	0.27	0.31	0.35	0.38	0.41	0.55	0.66	0.81	0.97	1.07
Consumption	-0.31	-0.24	-0.20	-0.16	-0.12	-0.09	-0.05	-0.02	0.01	0.04	0.16	0.25	0.39	0.52	0.61
Consumption by A Agents	1.50	1.48	1.62	1.73	1.83	1.92	2.00	2.07	2.13	2.19	2.40	2.54	2.69	2.83	2.91
Consumption by B Agents	-0.48	-0.40	-0.37	-0.33	-0.30	-0.27	-0.24	-0.21	-0.19	-0.16	-0.05	0.04	0.17	0.31	0.39
Investment	1.57	1.53	1.60	1.66	1.72	1.77	1.82	1.87	1.91	1.96	2.16	2.33	2.56	2.81	2.97
Capital Stock	0.15	0.29	0.41	0.54	0.65	0.76	0.86	0.96	1.05	1.14	1.52	1.82	2.24	2.68	2.96
Wealth	-1.17	-1.04	-0.97	-0.91	-0.84	-0.78	-0.72	-0.67	-0.62	-0.57	-0.36	-0.20	0.03	0.26	0.40
Wealth of A Agents	1.05	1.09	1.26	1.40	1.53	1.65	1.75	1.84	1.93	2.00	2.30	2.51	2.76	3.00	3.14
Wealth of B Agents	-1.35	-1.22	-1.16	-1.10	-1.04	-0.98	-0.93	-0.88	-0.83	-0.78	-0.58	-0.42	-0.20	0.03	0.18
Human Wealth	-1.05	-0.92	-0.85	-0.78	-0.71	-0.64	-0.58	-0.52	-0.47	-0.42	-0.19	-0.02	0.22	0.47	0.64
Capital Wealth	-1.61	-1.51	-1.47	-1.42	-1.38	-1.33	-1.29	-1.25	-1.22	-1.19	-1.04	-0.93	-0.77	-0.61	-0.53
Capital Income (1)	0.09	0.07	0.07	0.06	0.06	0.05	0.04	0.04	0.03	0.03	0.01	-0.01	-0.03	-0.05	-0.07
Earnings (1)	0.27	0.42	0.39	0.38	0.38	0.37	0.37	0.37	0.37	0.37	0.36	0.36	0.35	0.35	0.34
Earnings (2)	1.26	1.79	2.00	2.22	2.40	2.57	2.70	2.82	2.92	3.00	3.26	3.36	3.40	3.36	3.30
Equity Income (3)	3.75	3.72	4.48	4.48	4.52	4.53	4.55	4.56	4.58	4.59	4.64	4.67	4.67	4.69	4.75
Debt Servicing (1)	-2.23	-4.40	-4.02	-4.03	-4.04	-4.10	-4.15	-4.19	-4.23	-4.27	-4.48	-4.64	-4.93	-5.21	-5.30
Debt Servicing (2)	-9.53	-11.57	-11.23	-11.21	-11.19	-11.22	-11.23	-11.25	-11.27	-11.28	-11.38	-11.46	-11.64	-11.80	-11.85
Debt Servicing (3)	-5.33	-7.44	-7.08	-7.07	-7.08	-7.12	-7.15	-7.19	-7.22	-7.24	-7.40	-7.54	-7.77	-8.01	-8.08
Corporate Debt	-3.78	-6.07	-5.75	-5.62	-5.52	-5.44	-5.36	-5.29	-5.23	-5.18	-4.97	-4.83	-4.68	-4.54	-4.44
Equity	2.82	3.71	3.82	3.97	4.11	4.23	4.34	4.44	4.54	4.62	4.96	5.19	5.48	5.75	5.90
Firm Value	1.05	1.09	1.26	1.40	1.53	1.65	1.75	1.84	1.93	2.00	2.30	2.51	2.76	3.00	3.14
Retained Earnings Share	10.66	7.10	0.67	1.08	1.10	1.09	1.07	1.05	1.03	1.01	0.91	0.84	0.74	0.61	0.53
New Debt Issuance Share	-9.57	-6.14	0.24	-0.22	-0.28	-0.32	-0.34	-0.36	-0.37	-0.39	-0.42	-0.46	-0.50	-0.51	-0.53
CCA - New	6.21	6.33	6.37	6.40	6.44	6.47	6.50	6.53	6.55	6.58	6.67	6.74	6.82	6.91	6.94
CCA - Existing	5.16	6.28	7.44	8.43	9.30	10.06	10.73	11.31	11.82	12.27	13.84	14.71	15.57	16.18	16.48
CCA Base	0.97	2.04	2.96	3.75	4.45	5.06	5.59	6.05	6.45	6.81	8.05	8.74	9.41	9.88	10.14
Tobin Q	1.37	1.21	1.15	1.08	1.03	0.97	0.92	0.87	0.83	0.79	0.61	0.48	0.30	0.12	0.00
A Agent MPC from Wealth	0.44	0.38	0.35	0.33	0.30	0.27	0.25	0.22	0.20	0.18	0.10	0.03	-0.07	-0.16	-0.22
B Agent MPC from Wealth	0.88	0.83	0.80	0.77	0.74	0.72	0.69	0.67	0.65	0.63	0.54	0.47	0.37	0.28	0.21
Welfare of A Agents	1.90	1.84	1.94	2.02	2.09	2.15	2.20	2.25	2.29	2.32	2.44	2.50	2.56	2.60	2.62
Welfare of B Agents	0.40	0.42	0.42	0.43	0.43	0.44	0.45	0.45	0.46	0.46	0.49	0.51	0.54	0.58	0.61

(1) Pre-Corporate Tax, After Depreciation
(2) Pre-Personal Tax
(3) After-Personal Tax

Table A.2: Dynamic General Equilibrium Model Simulation Results
Rates of Return and Asset Positions (Shock Minus Control)
Control Dset is CTL Shock Dset is SHKPE2

Year	1	2	3	4	5	6	7	8	9	10	15	20	30	50	145
User Cost (1).....	-0.26	-0.25	-0.25	-0.26	-0.26	-0.26	-0.26	-0.27	-0.27	-0.27	-0.28	-0.29	-0.31	-0.33	-0.33
Marg. Prod. of Capital...	-0.02	-0.03	-0.05	-0.06	-0.07	-0.09	-0.10	-0.11	-0.12	-0.13	-0.17	-0.21	-0.25	-0.30	-0.33
Capital Return (1).....	-0.12	-0.12	-0.15	-0.16	-0.18	-0.19	-0.21	-0.22	-0.23	-0.24	-0.28	-0.30	-0.33	-0.36	-0.38
Capital Return (2).....	-0.02	-0.01	-0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.00	-0.01	-0.03	-0.05	-0.06
Capital Return (3).....	0.11	0.05	0.05	0.04	0.04	0.03	0.03	0.02	0.02	0.01	-0.00	-0.01	-0.03	-0.05	-0.05
Return on Equity (1).....	-0.39	-0.49	-0.52	-0.54	-0.56	-0.58	-0.59	-0.61	-0.62	-0.63	-0.68	-0.71	-0.76	-0.79	-0.82
Return on Equity (2).....	-0.12	-0.15	-0.14	-0.14	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.13	-0.14	-0.16	-0.18	-0.20
Return on Equity (3).....	0.14	0.05	0.05	0.04	0.03	0.03	0.02	0.02	0.01	0.01	-0.01	-0.02	-0.04	-0.05	-0.06
Real Corp. Bond Rate (2).	0.05	0.06	0.06	0.06	0.05	0.05	0.04	0.04	0.04	0.03	0.02	0.01	-0.01	-0.02	-0.03
Real Corp. Rate (Fisher).	-0.44	-0.43	-0.43	-0.44	-0.44	-0.45	-0.46	-0.46	-0.47	-0.48	-0.50	-0.51	-0.54	-0.56	-0.57
Real Corp. Bond Rate (3).	-0.07	-0.06	-0.06	-0.07	-0.07	-0.08	-0.08	-0.09	-0.09	-0.09	-0.11	-0.12	-0.14	-0.16	-0.17
Real Govt. Rate (Fisher).	-0.10	-0.19	-0.19	-0.20	-0.21	-0.22	-0.22	-0.23	-0.24	-0.24	-0.26	-0.28	-0.30	-0.32	-0.32
Real Govt. Bond Rate (3).	0.18	0.12	0.11	0.11	0.10	0.09	0.09	0.08	0.08	0.08	0.06	0.05	0.03	0.02	0.02
Capital Premium (3).....	-0.07	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.07
Equity Premium (3).....	-0.04	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07	-0.07
Corp. Bond Premium (3)...	-0.24	-0.17	-0.17	-0.17	-0.17	-0.17	-0.17	-0.17	-0.17	-0.17	-0.17	-0.17	-0.17	-0.17	-0.18
A Agent Risk-Adj. Rate...	0.15	0.08	0.08	0.08	0.07	0.06	0.06	0.05	0.05	0.05	0.03	0.02	0.00	-0.01	-0.02
B Agent Risk-Adj. Rate...	0.18	0.12	0.11	0.11	0.10	0.09	0.09	0.08	0.08	0.08	0.06	0.05	0.03	0.02	0.02
Leverage.....	-1.28	-1.90	-1.85	-1.85	-1.86	-1.86	-1.87	-1.87	-1.88	-1.88	-1.90	-1.91	-1.94	-1.96	-1.97
Total Saving Rate.....	0.29	0.28	0.28	0.28	0.29	0.29	0.29	0.29	0.30	0.30	0.31	0.32	0.34	0.35	0.36

(1) Pre-Corporate Tax
(2) After-Corporate Tax
(3) After-Personal Tax

Table A.3: Dynamic General Equilibrium Model Simulation Results
Rates of Return (Control Levels) Control Dset is CTL

Year	1	2	3	4	5	6	7	8	9	10	15	20	30	50	145
User Cost (1)	18.15	18.15	18.15	18.15	18.15	18.15	18.15	18.15	18.15	18.15	18.15	18.15	18.15	18.15	18.15
Marg. Prod. of Capital	18.15	18.15	18.15	18.15	18.15	18.15	18.15	18.15	18.15	18.15	18.15	18.15	18.15	18.15	18.15
Capital Return (1)	12.30	12.30	12.30	12.30	12.30	12.30	12.30	12.30	12.30	12.30	12.30	12.30	12.30	12.30	12.30
Capital Return (2)	6.87	6.87	6.87	6.87	6.87	6.87	6.87	6.87	6.87	6.87	6.87	6.87	6.87	6.87	6.87
Capital Return (3)	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59
Return on Equity (1)	15.57	15.57	15.57	15.57	15.57	15.57	15.57	15.57	15.57	15.57	15.57	15.57	15.57	15.57	15.57
Return on Equity (2)	8.16	8.16	8.16	8.16	8.16	8.16	8.16	8.16	8.16	8.16	8.16	8.16	8.16	8.16	8.16
Return on Equity (3)	6.04	6.04	6.04	6.04	6.04	6.04	6.04	6.04	6.04	6.04	6.04	6.04	6.04	6.04	6.04
Real Corp. Bond Rate (2)	3.34	3.34	3.34	3.34	3.34	3.34	3.34	3.34	3.34	3.34	3.34	3.34	3.34	3.34	3.34
Real Corp. Rate (Fisher)	7.38	7.38	7.38	7.38	7.38	7.38	7.38	7.38	7.38	7.38	7.38	7.38	7.38	7.38	7.39
Real Corp. Bond Rate (3)	4.35	4.35	4.35	4.35	4.35	4.35	4.35	4.35	4.35	4.35	4.35	4.35	4.35	4.35	4.35
Real Govt. Rate (Fisher)	6.47	6.47	6.47	6.47	6.47	6.47	6.47	6.47	6.47	6.47	6.47	6.47	6.47	6.47	6.47
Real Govt. Bond Rate (3)	3.68	3.69	3.69	3.69	3.68	3.69	3.69	3.69	3.69	3.69	3.69	3.69	3.69	3.69	3.69
Capital Premium (3)	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84
Equity Premium (3)	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27	2.27
Corp. Bond Premium (3)	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
A Agent Risk-Adj. Rate	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63	4.63
B Agent Risk-Adj. Rate	3.68	3.69	3.69	3.69	3.69	3.69	3.69	3.69	3.69	3.69	3.69	3.69	3.69	3.69	3.69
A Agent MPC from Wealth	3.71	3.71	3.71	3.71	3.71	3.71	3.71	3.71	3.71	3.71	3.71	3.71	3.71	3.71	3.71
B Agent MPC from Wealth	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27	3.27
Leverage	26.74	26.74	26.74	26.74	26.74	26.74	26.74	26.74	26.74	26.74	26.74	26.74	26.74	26.74	26.74
Total Saving Rate	19.41	19.41	19.41	19.41	19.41	19.41	19.41	19.41	19.41	19.41	19.41	19.41	19.41	19.41	19.41

(1) Pre-Corporate Tax
(2) After-Corporate Tax
(3) After-Personal Tax

Table A.4: Dynamic General Equilibrium Model Simulation Results
Rates of Return (Shock Levels) Shock Dset is SHKPE2

Year	1	2	3	4	5	6	7	8	9	10	15	20	30	50	145
User Cost (1).....	17.89	17.90	17.90	17.89	17.89	17.89	17.89	17.88	17.88	17.88	17.87	17.86	17.84	17.82	17.81
Marg. Prod. of Capital...	18.13	18.12	18.10	18.09	18.08	18.06	18.05	18.04	18.03	18.02	17.98	17.94	17.90	17.85	17.82
Capital Return (1).....	12.18	12.18	12.16	12.14	12.12	12.11	12.09	12.08	12.07	12.06	12.02	12.00	11.97	11.94	11.92
Capital Return (2).....	6.86	6.87	6.87	6.87	6.88	6.88	6.88	6.88	6.88	6.88	6.87	6.86	6.84	6.82	6.81
Capital Return (3).....	5.70	5.64	5.64	5.64	5.63	5.62	5.62	5.61	5.61	5.60	5.59	5.58	5.56	5.55	5.54
Return on Equity (1).....	15.19	15.08	15.06	15.03	15.01	14.99	14.98	14.96	14.95	14.94	14.89	14.86	14.81	14.78	14.75
Return on Equity (2).....	8.04	8.01	8.02	8.03	8.03	8.03	8.03	8.04	8.04	8.04	8.03	8.02	8.00	7.98	7.96
Return on Equity (3).....	6.18	6.09	6.09	6.08	6.08	6.07	6.06	6.06	6.05	6.05	6.03	6.02	6.01	5.99	5.99
Real Corp. Bond Rate (2).	3.39	3.40	3.40	3.40	3.39	3.39	3.38	3.38	3.38	3.37	3.36	3.35	3.33	3.32	3.31
Real Corp. Rate (Fisher).	6.94	6.95	6.96	6.95	6.94	6.93	6.93	6.92	6.91	6.91	6.89	6.87	6.85	6.82	6.81
Real Corp. Bond Rate (3).	4.28	4.29	4.29	4.28	4.28	4.27	4.27	4.27	4.26	4.26	4.24	4.23	4.21	4.19	4.19
Real Govt. Rate (Fisher).	6.37	6.28	6.28	6.27	6.26	6.26	6.25	6.24	6.24	6.23	6.21	6.19	6.17	6.16	6.15
Real Govt. Bond Rate (3).	3.87	3.80	3.80	3.79	3.79	3.78	3.78	3.77	3.77	3.76	3.75	3.74	3.72	3.71	3.70
Capital Premium (3).....	1.76	1.77	1.77	1.78	1.78	1.78	1.78	1.78	1.78	1.78	1.77	1.77	1.77	1.77	1.77
Equity Premium (3).....	2.23	2.21	2.21	2.21	2.21	2.21	2.21	2.21	2.20	2.20	2.20	2.20	2.20	2.20	2.20
Corp. Bond Premium (3) ..	0.40	0.47	0.47	0.47	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.47	0.47	0.47
A Agent Risk-Adj. Rate...	4.77	4.71	4.71	4.71	4.70	4.69	4.69	4.69	4.68	4.68	4.66	4.65	4.63	4.62	4.62
B Agent Risk-Adj. Rate...	3.87	3.80	3.80	3.79	3.79	3.78	3.78	3.77	3.77	3.76	3.75	3.74	3.72	3.71	3.70
A Agent MPC from Wealth..	3.73	3.72	3.72	3.72	3.72	3.72	3.72	3.72	3.72	3.72	3.71	3.71	3.71	3.70	3.70
B Agent MPC from Wealth..	3.30	3.30	3.30	3.30	3.30	3.30	3.29	3.29	3.29	3.29	3.29	3.29	3.28	3.28	3.28
Leverage.....	25.46	24.84	24.89	24.89	24.88	24.88	24.87	24.87	24.86	24.86	24.84	24.83	24.80	24.78	24.78
Total Saving Rate.....	19.70	19.69	19.69	19.69	19.70	19.70	19.70	19.70	19.71	19.71	19.72	19.73	19.75	19.77	19.78

(1) Pre-Corporate Tax
(2) After-Corporate Tax
(3) After-Personal Tax

Table A.5: Dynamic General Equilibrium Model Simulation Results
Tax Wedges and Effective Tax Rates (Shock Minus Control)
Control Dset is CTL Shock Dset is SHKPE2

Year	1	2	3	4	5	6	7	8	9	10	15	20	30	50	145
Tax Wedge Levels:															
Equity Wedge Personal....	-0.26	-0.20	-0.19	-0.18	-0.17	-0.16	-0.15	-0.14	-0.14	-0.13	-0.12	-0.12	-0.12	-0.13	-0.14
Equity Wedge Corporate...	-0.26	-0.34	-0.37	-0.40	-0.42	-0.45	-0.46	-0.48	-0.49	-0.51	-0.55	-0.57	-0.60	-0.61	-0.62
Debt Wedge Personal.....	-0.37	-0.37	-0.37	-0.37	-0.37	-0.37	-0.38	-0.38	-0.38	-0.38	-0.39	-0.39	-0.40	-0.40	-0.41
Debt Wedge Corporate.....	0.49	0.49	0.49	0.49	0.50	0.50	0.50	0.50	0.51	0.51	0.52	0.52	0.53	0.54	0.54
Debt Wedge.....	0.12	0.12	0.12	0.12	0.12	0.12	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.14
Equity Wedge	-0.53	-0.54	-0.56	-0.58	-0.59	-0.60	-0.61	-0.62	-0.63	-0.64	-0.67	-0.69	-0.72	-0.74	-0.76
Capital Wedge Personal...	-0.12	-0.06	-0.05	-0.04	-0.04	-0.03	-0.02	-0.02	-0.01	-0.01	0.00	0.00	0.00	-0.00	-0.01
Capital Wedge Corporate..	-0.10	-0.12	-0.14	-0.16	-0.18	-0.20	-0.21	-0.22	-0.23	-0.24	-0.27	-0.29	-0.30	-0.31	-0.32
Capital Wedge.....	-0.23	-0.18	-0.20	-0.21	-0.22	-0.23	-0.23	-0.24	-0.25	-0.25	-0.27	-0.29	-0.30	-0.32	-0.33
Tax Wedge Contributions:															
Equity Wedge Personal....	-0.16	-0.11	-0.10	-0.09	-0.09	-0.08	-0.07	-0.07	-0.06	-0.06	-0.05	-0.05	-0.05	-0.06	-0.07
Equity Wedge Corporate...	-0.05	-0.12	-0.14	-0.16	-0.18	-0.20	-0.21	-0.22	-0.23	-0.24	-0.27	-0.29	-0.30	-0.31	-0.32
Debt Wedge Personal.....	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.16	-0.16	-0.16	-0.16
Debt Wedge Corporate.....	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.21	0.21	0.21	0.21
Debt Wedge.....	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Equity Wedge	-0.21	-0.23	-0.24	-0.26	-0.27	-0.27	-0.28	-0.29	-0.30	-0.30	-0.32	-0.34	-0.36	-0.37	-0.38
Effective Tax Rates:															
Equity Personal.....	-0.03	-0.02	-0.02	-0.02	-0.02	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Equity Corporate.....	-0.01	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.03	-0.03	-0.03	-0.03	-0.03
Debt Personal.....	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03
Debt Corporate.....	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03
Debt	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Equity	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.03
Capital Personal.....	-0.03	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
Capital Corporate.....	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Capital.....	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01

Table A.6 Dynamic General Equilibrium Model Simulation Results
Tax Wedges and Effective Tax Rates (Control Levels)
Control Dset is CTL

Year	1	2	3	4	5	6	7	8	9	10	15	20	30	50	145
Tax Wedge Levels:															
Equity Wedge Personal....	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12
Equity Wedge Corporate...	7.41	7.41	7.41	7.41	7.41	7.41	7.41	7.41	7.41	7.41	7.41	7.41	7.41	7.41	7.41
Debt Wedge Personal.....	3.03	3.03	3.03	3.03	3.03	3.03	3.03	3.03	3.03	3.03	3.03	3.03	3.03	3.03	3.03
Debt Wedge Corporate.....	-4.04	-4.04	-4.04	-4.04	-4.04	-4.04	-4.04	-4.04	-4.04	-4.04	-4.04	-4.04	-4.04	-4.04	-4.04
Debt Wedge.....	-1.01	-1.01	-1.01	-1.01	-1.01	-1.01	-1.01	-1.01	-1.01	-1.01	-1.01	-1.01	-1.01	-1.01	-1.01
Equity Wedge	9.53	9.53	9.53	9.53	9.53	9.53	9.53	9.53	9.53	9.53	9.53	9.53	9.53	9.53	9.53
Capital Wedge Personal...	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28
Capital Wedge Corporate..	5.43	5.43	5.43	5.43	5.43	5.43	5.43	5.43	5.43	5.43	5.43	5.43	5.43	5.43	5.43
Capital Wedge.....	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71
Tax Wedge Contributions:															
Equity Wedge Personal....	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55
Equity Wedge Corporate...	5.43	5.43	5.43	5.43	5.43	5.43	5.43	5.43	5.43	5.43	5.43	5.43	5.43	5.43	5.43
Debt Wedge Personal.....	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
Debt Wedge Corporate.....	-1.08	-1.08	-1.08	-1.08	-1.08	-1.08	-1.08	-1.08	-1.08	-1.08	-1.08	-1.08	-1.08	-1.08	-1.08
Debt Wedge.....	-0.27	-0.27	-0.27	-0.27	-0.27	-0.27	-0.27	-0.27	-0.27	-0.27	-0.27	-0.27	-0.27	-0.27	-0.27
Equity Wedge	6.98	6.98	6.98	6.98	6.98	6.98	6.98	6.98	6.98	6.98	6.98	6.98	6.98	6.98	6.98
Effective Tax Rates:															
Equity Personal.....	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.260	0.259
Equity Corporate.....	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526	0.526
Debt Personal.....	0.411	0.411	0.411	0.411	0.411	0.411	0.411	0.411	0.411	0.411	0.411	0.411	0.411	0.411	0.411
Debt Corporate.....-0.188	-0.188	-0.188	-0.188	-0.188	-0.188	-0.188	-0.187	-0.187	-0.187	-0.187	-0.188	-0.187	-0.188	-0.187	
Debt	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
Equity	0.649	0.649	0.649	0.649	0.649	0.649	0.649	0.649	0.649	0.649	0.649	0.649	0.649	0.649	0.649
Capital Personal.....	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
Capital Corporate.....	0.335	0.335	0.335	0.335	0.335	0.335	0.335	0.335	0.335	0.335	0.335	0.335	0.335	0.335	0.335
Capital.....	0.535	0.534	0.534	0.534	0.534	0.534	0.534	0.534	0.534	0.534	0.534	0.534	0.534	0.534	0.534

Table A.7 Dynamic General Equilibrium Model Simulation Results
Tax Wedges and Effective Tax Rates (Shock Levels)
Shock Dset is SHKPE2

Year	1	2	3	4	5	6	7	8	9	10	15	20	30	50	145
Tax Wedge Levels:															
Equity Wedge Personal....	1.86	1.92	1.93	1.94	1.95	1.96	1.97	1.98	1.98	1.99	2.00	2.00	2.00	1.99	1.97
Equity Wedge Corporate...	7.15	7.06	7.04	7.01	6.98	6.96	6.94	6.93	6.91	6.90	6.86	6.83	6.81	6.80	6.79
Debt Wedge Personal.....	2.66	2.66	2.66	2.66	2.66	2.66	2.66	2.65	2.65	2.65	2.65	2.64	2.63	2.63	2.63
Debt Wedge Corporate.....	-3.55	-3.55	-3.55	-3.55	-3.55	-3.54	-3.54	-3.54	-3.54	-3.54	-3.53	-3.52	-3.51	-3.50	-3.50
Debt Wedge.....	-0.89	-0.89	-0.89	-0.89	-0.89	-0.89	-0.89	-0.89	-0.88	-0.88	-0.88	-0.88	-0.88	-0.88	-0.88
Equity Wedge	9.00	8.99	8.97	8.95	8.94	8.92	8.91	8.90	8.89	8.89	8.85	8.83	8.81	8.78	8.77
Capital Wedge Personal...	1.16	1.22	1.23	1.24	1.25	1.25	1.26	1.26	1.27	1.27	1.28	1.28	1.28	1.28	1.27
Capital Wedge Corporate..	5.33	5.31	5.28	5.26	5.25	5.23	5.22	5.20	5.19	5.19	5.15	5.14	5.12	5.11	5.11
Capital Wedge.....	6.49	6.53	6.51	6.50	6.49	6.48	6.48	6.47	6.46	6.46	6.44	6.42	6.41	6.39	6.38
Tax Wedge Contributions:															
Equity Wedge Personal....	1.40	1.44	1.45	1.46	1.47	1.47	1.48	1.48	1.49	1.49	1.50	1.50	1.50	1.49	1.49
Equity Wedge Corporate...	5.38	5.31	5.28	5.26	5.25	5.23	5.22	5.20	5.19	5.19	5.15	5.14	5.12	5.11	5.11
Debt Wedge Personal.....	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.65	0.65	0.65
Debt Wedge Corporate.....	-0.88	-0.88	-0.88	-0.88	-0.88	-0.88	-0.88	-0.88	-0.88	-0.88	-0.88	-0.87	-0.87	-0.87	-0.87
Debt Wedge.....	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22
Equity Wedge	6.77	6.75	6.73	6.72	6.71	6.70	6.70	6.69	6.68	6.68	6.66	6.64	6.62	6.61	6.59
Effective Tax Rates:															
Equity Personal.....	0.231	0.240	0.241	0.242	0.243	0.244	0.245	0.246	0.247	0.247	0.249	0.249	0.249	0.249	0.248
Equity Corporate.....	0.511	0.508	0.507	0.506	0.505	0.504	0.503	0.502	0.502	0.501	0.500	0.499	0.499	0.499	0.499
Debt Personal.....	0.383	0.383	0.383	0.383	0.383	0.383	0.384	0.384	0.384	0.384	0.384	0.384	0.385	0.385	0.385
Debt Corporate.....	-0.151	-0.151	-0.151	-0.151	-0.151	-0.151	-0.151	-0.152	-0.152	-0.152	-0.152	-0.153	-0.153	-0.154	-0.154
Debt	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.291	0.291	0.291	0.291
Equity	0.624	0.626	0.626	0.625	0.625	0.625	0.625	0.625	0.625	0.624	0.624	0.624	0.624	0.624	0.624
Capital Personal.....	0.269	0.276	0.276	0.277	0.278	0.279	0.280	0.280	0.281	0.281	0.282	0.283	0.283	0.283	0.282
Capital Corporate.....	0.347	0.344	0.343	0.342	0.341	0.341	0.340	0.340	0.339	0.339	0.338	0.337	0.337	0.337	0.337
Capital.....	0.523	0.525	0.525	0.525	0.525	0.525	0.525	0.525	0.525	0.525	0.525	0.525	0.525	0.525	0.524

Appendix
The Simulation Model

A.1 Mnemonics

A.11 Endogenous Variables

Y	commercial sector output
L	labour input
K	capital input
C^A	household A consumption
C^B	household B consumption
C	consumption
I	investment
m^A	household A propensity to consume out of wealth
m^B	household B propensity to consume out of wealth
$\hat{r}^A$	household A risk-adjusted rate
$\hat{r}^B$	household B risk-adjusted rate
Q	adjusted Q
$\hat{e}$	pre-personal tax return on equity
e	after-personal tax return on equity
r^G	government bond rate
r^C	corporate bond rate
σ^2	variance of rate of return on capital
S	market value of equity
B^C	stock of corporate bonds
Z	present value of capital consumption allowances on existing capital
z	present value of capital consumption allowances on a dollar of new capital
b	corporate leverage
Y^L	commercial sector labour income
Y^K	commercial sector capital income
W^K	pre-tax physical capital wealth
W^L	tax and transfer-adjusted human capital wealth
W^A	wealth of type-A households
W^B	wealth of type-B households
W	total wealth
$\hat{E}$	pre-corporate tax earnings
E	after-corporate tax earnings
K^T	capital consumption allowance base
R	retained earnings
D	dividends
ϕ	capital installation costs per unit of investment
Ψ	corporate bond capital income risk share
Ψ^M	marginal corporate bond capital income risk share
$\tilde{K}^T$	nominal capital consumption allowance base
P	price level
V^A	welfare of type-A households

V^B welfare of type-B households

A.12 Exogenous Variables

q total factor productivity
π rate of price inflation
ρ rate of time preference
τ^{KE} average tax rate on equity income
τ^{KD} tax rate on dividends
τ^{KK} tax rate on capital gains
τ^{KB} tax rate on interest income
Γ investment tax credit rate
τ^{KC} tax rate on corporate income
δ rate of economic depreciation
δ^T rate of capital consumption allowance
λ bankruptcy cost measure
σ^{K2} capital return variance

A.13 Parameters

ξ coefficient of relative risk aversion
ω calibration parameter
θ installation cost parameter
β installation cost parameter
α labour income share
μ leverage cost parameter
ν inventory valuation adjustment parameter

A.14 Equations

Output:

$$Y_t = q_t L_t^{\alpha} K_t^{1-\alpha} + G_t^Y \tag{A.1}$$

Aggregate demand:

$$Y_t = C_t + I_t \tag{A.2}$$

Consumption by type-A households:

$$C_t^A = m_t^A W_t^A \tag{A.3}$$

Consumption by type-B households:

$$C_t^B = m_t^B W_t^B \tag{A.4}$$

Propensity to consume by type-A households:

$$(m_t^A)^{-1} = 1 + (m_{t+1}^A)^{-1} (1 + \hat{r}_t^A)^{\xi(1-\xi)}/(1+\rho)^{1(1-\xi)} \tag{A.5}$$

Propensity to consume by type-B households:

$$(m_t^B)^{-1} = 1 + (m_{t+1}^B)^{-1} (1 + \hat{r}_t^B)^{\xi(1-\xi)}/(1+\rho)^{1(1-\xi)} \tag{A.6}$$

Risk-adjusted return of type-A households:

$$1 + \hat{r}_t^A = \{[1 + r_t^G (1 - \tau_{t+1}^{KB})]/(1 + \pi_{t+1})\}\exp\{\tfrac{1}{2}(1-\xi)\sigma_{t+1}^2 (1 - \tau_{t+1}^{KC})^2$$

$$\{(1 - \tau_{t+1}^{KE})^2(1 - \Psi_t) + \{[r_t^C (1 - \tau_{t+1}^{KB}) - \pi_{t+1}]/(r_t^C - \pi_{t+1})\}^2\lambda_t\}\} \tag{A.7}$$

Risk-adjusted return of type-B households:

$$1 + \hat{r}_t^B = [1 + r_t^G (1 - \tau_{t+1}^{KB})]/(1 + \pi_{t+1}) \tag{A.8}$$

Consumption:

$$C_t = C_t^A + C_t^B \tag{A.9}$$

Investment:

$$I_t/K_t = \theta + Q_t/\beta \tag{A.10}$$

Tax-adjusted Q:

$$Q_t = (S_t + B_t^C - Z_t)/K_t - 1 + \Gamma_t + z_t \tag{A.11}$$

Return on equity:

$$1 + e_t = \{[1 + r_t^G (1 - \tau_{t+1}^{KB})]/(1 + \pi_{t+1})\}$$
$$\exp\{(1 - \xi)\sigma_{t+1}^2 (1 - \tau_{t+1}^{KE})^2(1 - \tau_{t+1}^{KC})^2(1 - \Psi_t)/(1 - b_t)\} \quad \text{(A.12)}$$

Corporate bond rate:

$$1 + r_t^C = (1 + r_t^G)\exp\{(1 - \xi)\sigma_{t+1}^2$$
$$\{[r_t^C (1 - \tau_{t+1}^{KB}) - \pi_{t+1}]/(r_t^C - \pi_{t+1})\}^2\lambda(\Psi_t/b_t)/(1 - \tau_{t+1}^{KB})\} \quad \text{(A.13)}$$

Pre-tax labour income:

$$Y_t^L = \alpha Y_t \quad \text{(A.14)}$$

Pre-tax gross capital income:

$$Y_t^K = (1 - \alpha)Y_t \quad \text{(A.15)}$$

Wealth of Type A Households:

$$W_t^A \equiv S_t + B_t^C \quad \text{(A.16)}$$

Wealth of Type B Households:

$$W_t^B \equiv W_t^K + W_t^L - S_t - B_t^C \quad \text{(A.17)}$$

Total Wealth:

$$W_t = W_t^A + W_t^B \quad \text{(A.18)}$$

Pre-tax capital wealth:

$$W_t^K = Y_t^K - \delta K_{t-1} + W_{t+1}^K/(1 + \gamma_t^{KAP}) \quad \text{(A.19)}$$

Pre-tax and transfer human wealth:

$$W_t^L = Y_t^L + W_{t+1}^L(1 + \pi_{t+1})/\{[1 + r_t^{GD}(1 - \tau_t^{KB})](1 + \omega_t)\} \quad \text{(A.20)}$$

Ratio of after-tax to pre-tax capital income:

$$k_t = (1 - \tau_t^{KE})E_t/(Y_t^K - \delta K_{t-1}) \quad \text{(A.21)}$$

Capital income discount rate:

$$\gamma_t^{KAP} = k_t(1 + \gamma_t^{AP})$$

$$+ (1 - k_t)\{[1 + r_t^{GD}(1 - \tau_{t+1}^{KB})]/(1 + \pi_{t+1}) - 1\} \quad \text{(A.22)}$$

After-personal tax return on capital:

$$\gamma_t^{AP} = b_t\{[1 + r_t^{CD}(1 - \tau_{t+1}^{KB})]/(1 + \pi_{t+1}) - 1\} + (1 - b_t)\hat{e}_t^{D} \quad \text{(A.23)}$$

Pre-corporate tax earnings:

$$\hat{E}_t = Y_t^K - \delta K_{t-1} - [(1 + r_{t-1}^C)/(1 + \pi_t) - 1]B_{t-1}^C \quad \text{(A.24)}$$

After-corporate tax earnings:

$$E_t = \hat{E}_t - \tau_t^{KC}[Y_t^K - r_{t-1}^C B_{t-1}^C/(1 + \pi_t)]$$

$$+ \tau_t^{KC}\delta_t^T K_{t-1}^T - \tau_t^{KC}\pi_t[vY_t + (1 - v)Y_{t-1}](1 - v) \quad \text{(A.25)}$$

Disposition of earnings:

$$E_t = R_t + D_t \quad \text{(A.26)}$$

Investment uses and sources:

$$(1 - \Gamma_t + \phi_t)I_t = R_t + B_t^C - B_{t-1}^C \quad \text{(A.27)}$$

Capital installation costs:

$$\phi_t = \begin{cases} \dfrac{(\beta/2)(I_t/K_t - \theta)^2}{I_t/K_t} & : I_t/K_t \geq \theta \\ 0 & : I_t/K_t < \theta \end{cases} \quad \text{(A.28)}$$

Corporate debt:

$$B_t^C = b_t S_t/(1 - b_t) \quad \text{(A.29)}$$

After-personal tax return on equity:

$$e_t = (1 - \tau_{t+1}^{KE})\left(\frac{D_{t+1}}{S_t} + \frac{\Delta S_{t+1} - \Delta S_{t+1}^{\wedge}}{S_t}\right) \quad \text{(A.30)}$$

Average tax rate on equity income:

$$1 - \tau_{t+1}^{KE} \equiv \frac{(1 - \tau_{t+1}^{KD})\frac{D_{t+1}}{S_t} + (1 - \tau_{t+1}^{KK})\frac{\Delta S_{t+1} - \Delta S_{t+1}^{N}}{S_t} - \tau_{t+1}^{KK}\,\pi_{t+1}}{\frac{D_{t+1}}{S_t} + \frac{\Delta S_{t+1} - \Delta S_{t+1}^{N}}{S_t}} \tag{A.31}$$

Determination of optimal leverage:

$$\Psi_t^M = \frac{\frac{r_t^G(1 - \tau_{t+1}^{KB}) - \pi_{t+1}}{1 - \tau_{t+1}^{KE}} - r_t^G(1 - \tau_{t+1}^{KC}) + \pi_{t+1}}{[(\frac{(1 - \tau_{t+1}^{KB})r_t^C - \pi_{t+1}}{r_t^C - \pi_{t+1}})^2 \lambda \frac{1 - \tau_{t+1}^{KC}}{1 - \tau_{t+1}^{KB}} - (1 - \tau_{t+1}^{KE})]\sigma_{t+1}^2(1 - \tau_{t+1}^{KC})^2(1 - \xi)} \tag{A.32}$$

Corporate bond capital income risk share:

$$\Psi_t = \begin{cases} b_t^{\mu} - \bar{b} \,;\, b_t^{\mu} \geq \bar{b} \\ 0 \,;\, b_t^{\mu} < \bar{b} \end{cases} \tag{A.33}$$

Marginal corporate bond capital income risk share:

$$\Psi_t^M = \begin{cases} \mu b_t^{\mu-1} \,;\, b_t^{\mu} \geq \bar{b} \\ 0 \,;\, b_t^{\mu} < \bar{b} \end{cases} \tag{A.34}$$

Capital stock:

$$K_t = (1 - \delta)(K_{t-1} + I_{t-1}) \tag{A.35}$$

Nominal capital consumption allowance base:

$$\tilde{K}_t^T = (1 - \delta_t^T)(\tilde{K}_{t-1}^T + P_{t-1}I_{t-1}) \tag{A.36}$$

Capital consumption allowance base:

$$K_t^T = \tilde{K}_t^T / P_t \tag{A.37}$$

Price of output:

$$P_t = P_{t-1}(1 + \pi_t) \tag{A.38}$$

Present value of capital consumption allowances on existing capital:

$$Z_t = [(1 - \delta_t^T)z_t + \tau_t^{KC}\,\delta_t^T]K_{t-1}^T \tag{A.39}$$

Present value of capital consumption allowances on a dollar of new capital:

$$z_t = \frac{\tau_{t+1}^{KC}\ \delta_{t+1}^{T} + z_{t+1}}{1 + \dfrac{e_t + \tau_{t+1}^{KK}\ \pi_{t+1}}{1 - \tau_{t+1}^{KK}}} \tag{A.40}$$

Capital return variance:

$$\sigma_t^{K2}\,[(1 - b_t)(1 - \Psi_t) + b_t\lambda\Psi_t] = \sigma_t^{2}\,(1 - \tau_{t+1}^{KC})^2$$

$$[(1 - b_t)(1 - \tau_{t+1}^{KE})^2(1 - \Psi_t) + b_t(\frac{r_t^{C}\ (1 - \tau_{t+1}^{KB}) - \pi_{t+1}}{r_t^{C} - \pi_{t+1}})^2\lambda\Psi_t] \tag{A.41}$$

Welfare of type-A households:

$$V_t^{A} = (m_t^{A})^{\xi-1}(W_t^{A})^{\xi}/\xi \tag{A.42}$$

Welfare of type-B households:

$$V_t^{B} = (m_t^{B})^{\xi-1}(W_t^{B})^{\xi}/\xi \tag{A.44}$$

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